

INTRODUCTION

How to Use This Manual

This manual contains information regarding repair procedures for the B 16 A engine. For information regarding installation and emission control system, please consult the Chassis maintenance and repair manual for the vehicle concerned.

This manual is divided into 6 sections. The first page of each section is numbered with a black tab that lines up with one of the thumb index tabs on this page. You can quickly find the first page of each section without looking through a full table of contents.

Each section includes:

1. A table of contents, or an exploded view index showing:
 - Parts disassembly sequence.
 - Bolt torques and thread sizes.
 - Page references to descriptions in text.
2. Disassembly/assembly procedures and tools.
3. Inspection.
4. Repair.
5. Adjustments.

Special Information

▲ WARNING Indicates a strong possibility of severe personal injury or loss of life if instructions are not followed.

CAUTION: Indicates a possibility of personal injury or equipment damage if instructions are not followed.

NOTE: Gives helpful information.

CAUTION: Detailed descriptions of *standard* workshop procedures, safety principles and service operations are not included. Please note that this manual does contain warnings and cautions against some specific service methods which could cause **PERSONAL INJURY**, or could damage a vehicle or make it unsafe. Please understand that these warnings cannot cover all conceivable ways in which service, whether or not recommended by Honda Motor, might be done, or of the possible hazardous consequences of each conceivable way, nor could Honda Motor investigate all such ways. Anyone using service procedures or tools, whether or not recommended by Honda Motor, *must satisfy himself thoroughly* that neither personal safety nor vehicle safety will be jeopardized.

All information contained in this manual is based on the latest product information available at the time of printing. We reserve the right to make changes at any time without notice. No part of this publication may be reproduced, stored in retrieval system, or transmitted, in any form by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of the publisher. This includes text, figures and tables.

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Service Publication Office

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Preparation of Work

General

CAUTION: Observe all safety precautions and notes while working.

1. Work safely and give your work your undivided attention. When either the front or rear wheels are to be raised, block the remaining wheels securely. Communicate as frequently as possible when a work involves two or more workers. Do not run the engine unless the shop or working area is well ventilated.



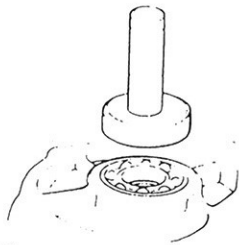
2. Prior to removing or disassembling parts, they must be inspected carefully to isolate the cause for which service is necessary. Observe all safety notes and precautions and follow the proper procedures as described in this manual.



3. Mark or place all removed parts in order in a parts rack so they can be reassembled in their original places.

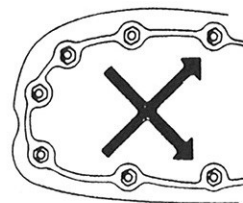


4. Use the special tools when use of such is specified.

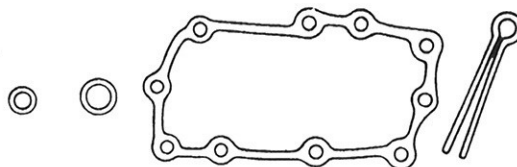


5. Parts must be assembled with the proper torques or tightness according to the maintenance standards established.

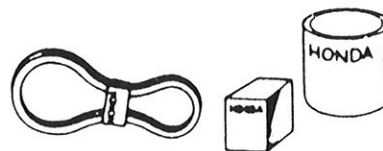
6. When tightening a series of bolts or nuts, begin with the center or large diameter bolts and tighten them in a crisscross pattern in two or more steps.



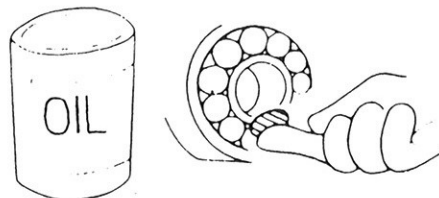
7. Use new packings, gaskets, O-rings and cotter pins whenever reassembling.



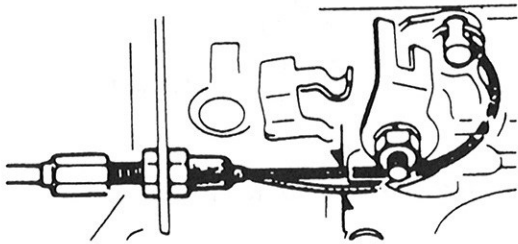
8. Use genuine HONDA parts and lubricants or those equivalent. When parts are to be reused, they must be inspected carefully to make sure they are not damaged or deteriorated and are in good usable condition.



9. Coat or fill parts with specified grease as specified. Clean all removed parts with solvent upon disassembly.

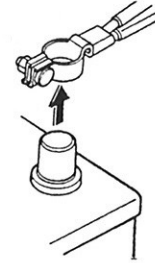


10. Apply liquid gasket to the camshaft holders, oil pump cover and right side cover. Use Honda genuine liquid gasket Part No. OY740-99986.
 - Check that the mating surfaces are clean and dry before applying liquid gasket. Degrease the mating surfaces if necessary.
 - Apply liquid gasket evenly, being careful to cover all the mating surface.
 - To prevent leakage of oil, apply liquid gasket to the inner threads of the bolt holes.
 - Do not install the parts if 20 minutes or more have elapsed since applying liquid gasket. Instead reapply liquid gasket after removing the old residue.
 - Wait at least 30 minutes before filling with appropriate liquid (engine oil, coolant and similar fluids).
11. Avoid oil or grease getting on rubber parts and tubes.
12. Upon assembling, check every possible parts for proper installation and movement or operation.

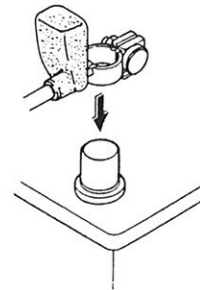


Electrical

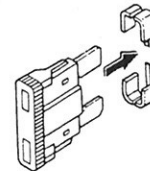
- Before making any repairs on electric wires or parts, disconnect the battery cables from the battery starting with the negative (-) terminal.



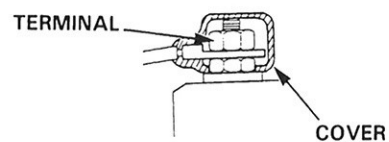
- After making repairs, check each wire or part for proper routing and installation. Also check to see that they are connected properly.
- Always connect the battery positive (+) cable first, then connect the negative (-) cable.



- Coat the terminals with clean grease after connecting the battery cables.
- Don't forget to install the terminal cover over the positive battery terminal after connecting.
- Before installing a new fuse, isolate the cause and take corrective measures, particularly when frequent fuse failure occurs.



- Be sure to install the terminal cover over the connections after a wire or wire harness has been connected.



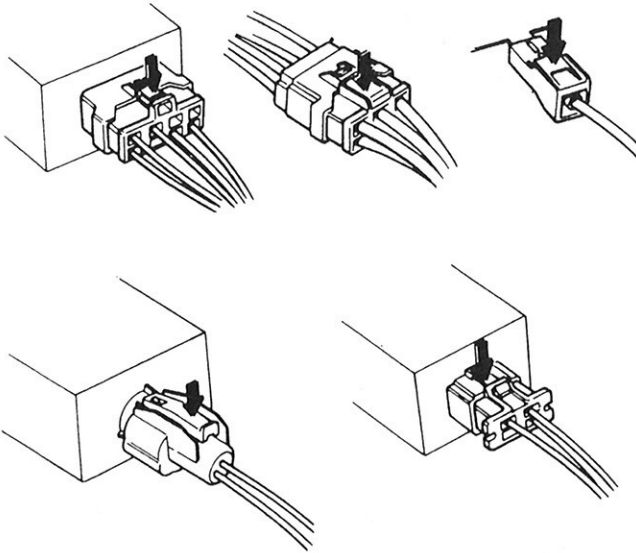
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Preparation of Work

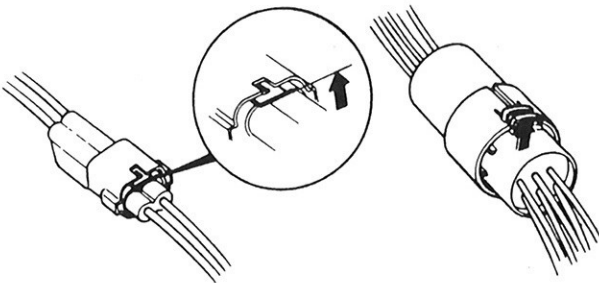
Electrical (cont'd)

- As locking-connectors, be sure to disengage the lock before disconnecting.
- Conventional connectors may be of two types, those in which the lock is pressed to remove, and those in which the lock is pulled up to remove. Be sure to ascertain the type of locking device before beginning work. The following is a depiction of the means of disconnecting various typical connectors.

Press to disengage:

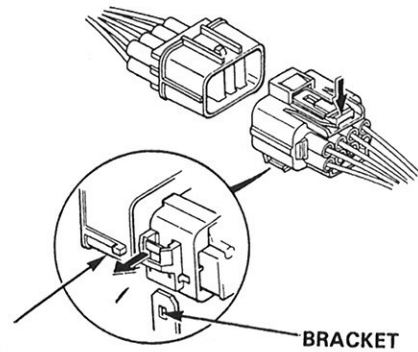


Pull up to disengage:

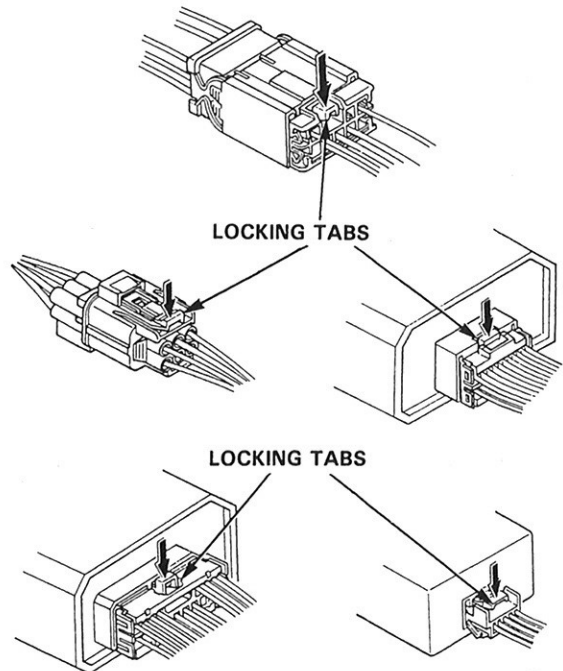


When new type connectors are used, connection and disconnection of them should be done paying attention to the following precautions.

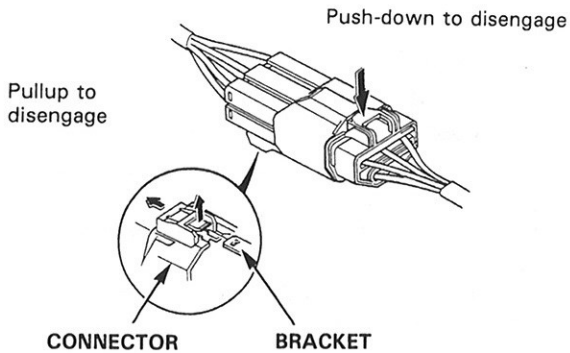
- Because all the connectors except terminal of 1-P are equipped with push-down type locks, unlock them first before disconnecting the connectors.
- On the connectors installed on the bracket a pull type lock is equipped between the bracket and the connectors.
Some connectors of this type can not be disconnected unless they are removed from their brackets.
When disconnecting, check their shapes.
- On the bracket mounted connector with dual locks, remove the connector from the bracket before disconnecting.



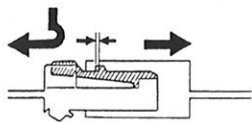
- Push the locking tab to disconnect.



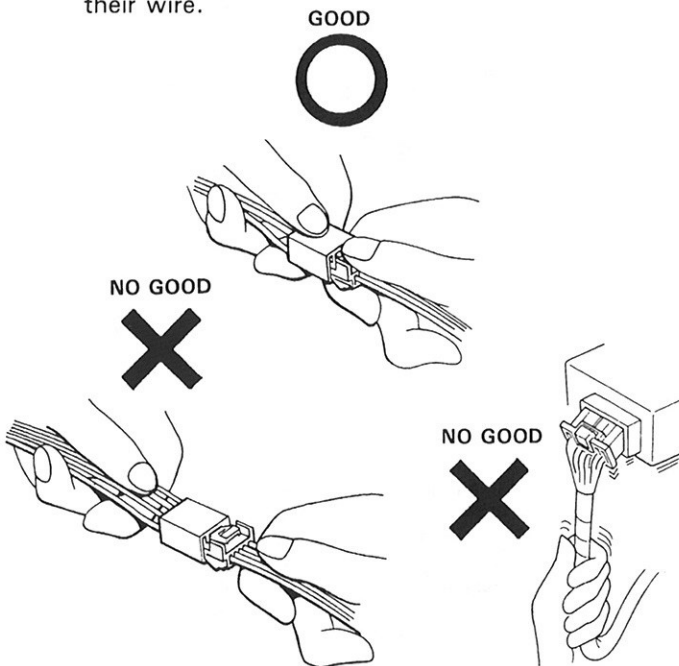
- Pull up the locking tab to remove the connector from the bracket.



- When disconnecting locks, first press in the connector tightly (to provide clearance to the locking device), then operate the tab fully and remove the connector in the designated manner.



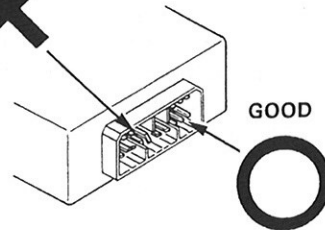
- When disconnecting a connector, pull it off from the mating coupler by holding on both connectors.
- Never try to disconnect connectors by pulling on their wire.



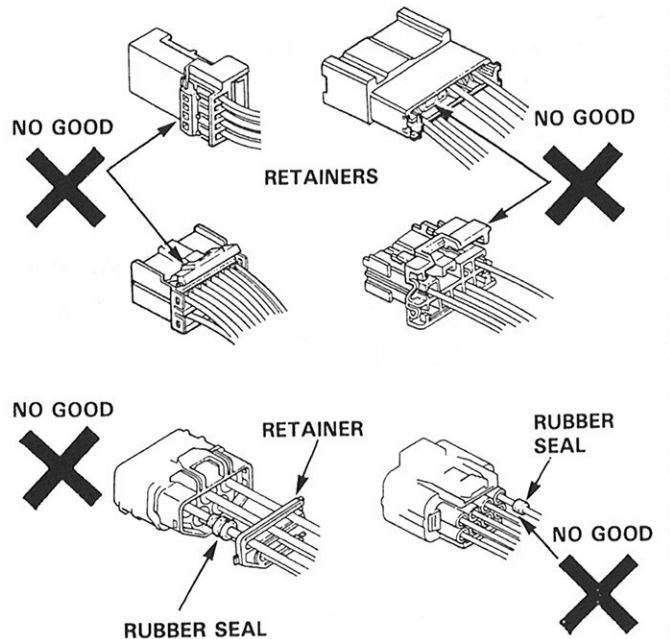
- Place the plastic cover over the mating connector after reconnecting. Also check that the cover is not distorted.



- Before connecting connectors, check to see that the terminals are in place and are not bent or distorted.



- Check for loose terminal locks and rubber seals. The illustration shows examples of terminal and seal abnormality.

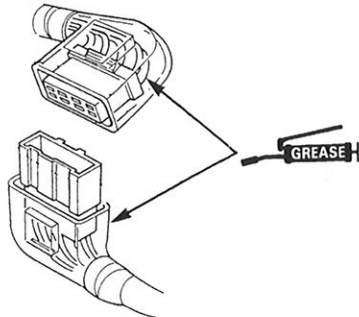


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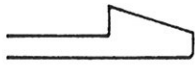
Preparation of Work

Electrical (cont'd)

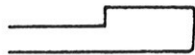
- For the connector which uses insulation grease, clean the connector then apply grease if the grease is insufficient or contaminated.



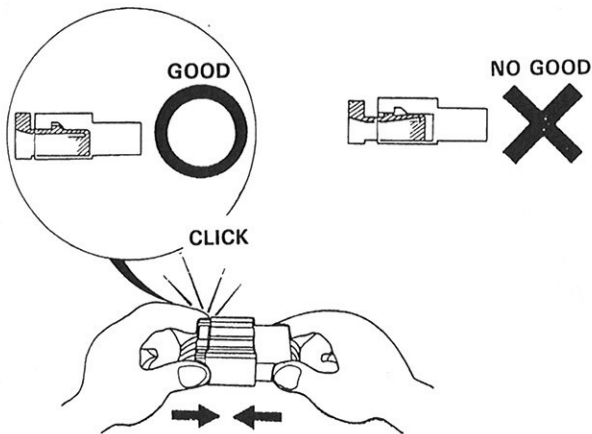
- Insert the connector tightly and make sure it is securely locked.
- Check all the wire harnesses are connected.
- There are two types of locking tab: one that you have to push and the other you should not touch when connecting the connector. Check the shape of the locking tab before connecting.
- The locking tab having a taper end should not be touched when connecting.



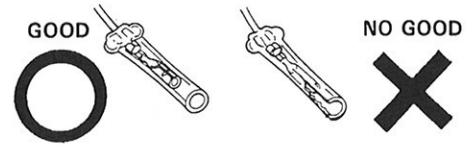
- The locking tab with an angle end should be pushed when connecting.



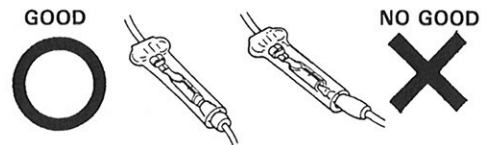
- Insert connectors fully until they will no longer go.
- The connectors must be aligned and engaged securely.
- Don't use wire harnesses with a loss wire or coupler.



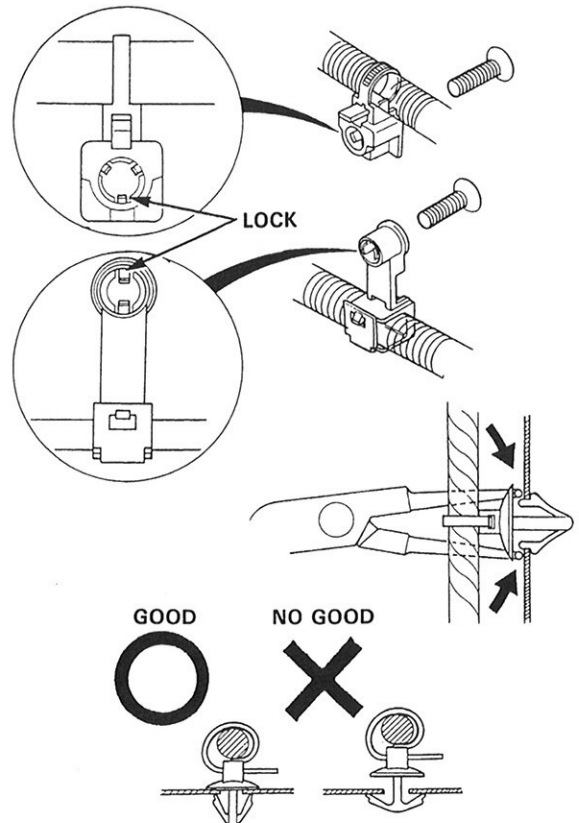
- Before connecting, check each connector cover for damage. Also make sure that the female connector is tight and not loosened from the previous use.

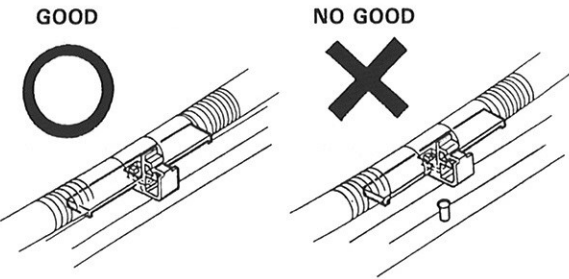
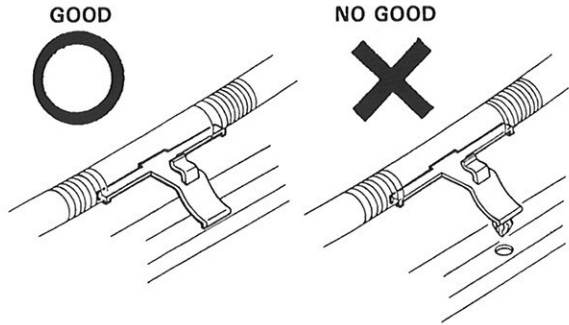


- Insert male connectors into the female connectors fully until they no longer go.
- Be sure that plastic cover is placed over the connection.
- Position the wires so that the open of the cover is not facing upward.

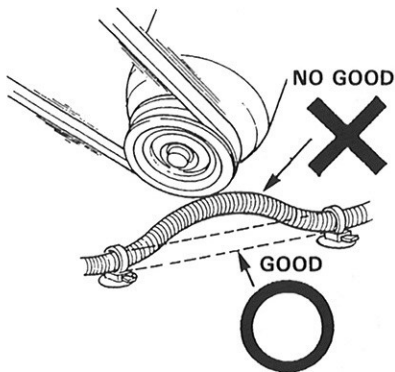


- Secure wires and wire harnesses to the frame with their respective wire bands at the designated locations. Position the wiring in the bands so that only the insulated surfaces contact the wires or wire harnesses.
- Remove with care not to damage the lock.

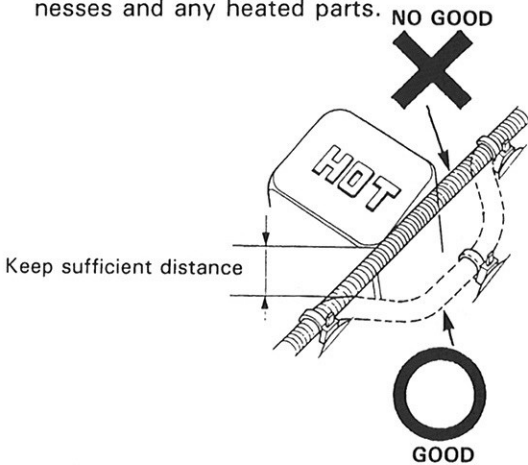




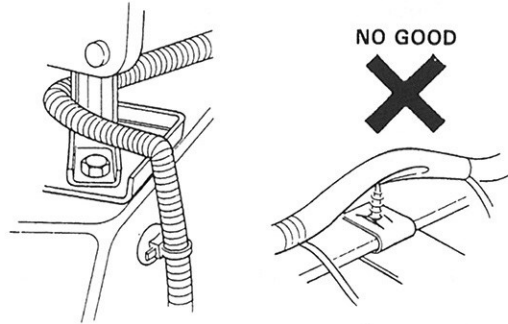
- After calmping, check each harness to be certain that it is not interfering with any moving or sliding parts of the vehicle.
- Keep wire harnesses away from the exhaust pipes and other hot parts.



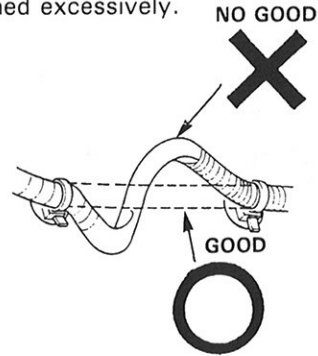
- Always keep a safe distance between wire harnesses and any heated parts.



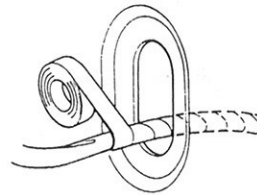
- Do not bring wire harnesses in direct contact with sharp edges or corners.
- Also avoid contact with the projected ends of bolts, screws and other fasteners.



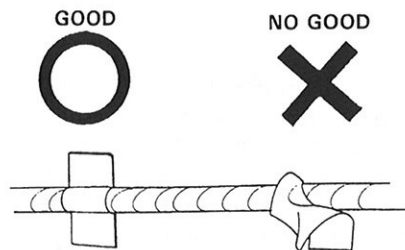
- Route harnesses so they are not pulled taut or slackened excessively.



- Protect wires and harnesses with a tape or a tube if they are in contact with a sharp edge or corner.



- Clean the attaching surface thoroughly if an adhesive is used. First, wipe with solvent or alcohol if necessary.

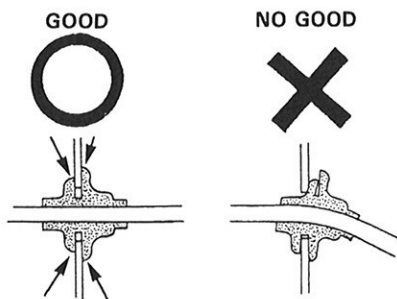


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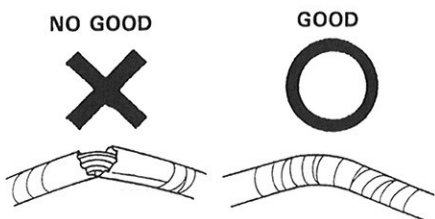
Preparation of Work

Electrical (cont'd)

- Seat grommets in their grooves properly.



- Do not damage the insulation when connecting a wire.
- Do not use wires or harnesses with a broken insulation. Repair by wrapping with protective tape or replace with new ones if necessary.

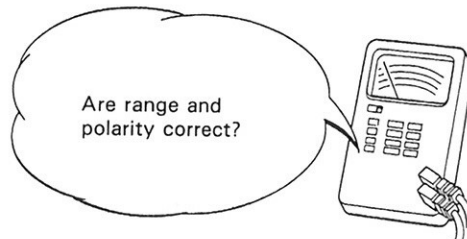


- After installing parts, make sure that wire harnesses are not pinched.

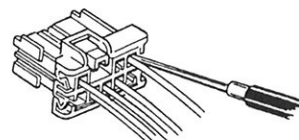


- After routing, check that the wire harnesses are not twisted or kinked.
- Wire harnesses should be routed so that they are not pulled taut, slackened excessively, pinched, or interfering with adjacent or surrounding parts in all steering positions.

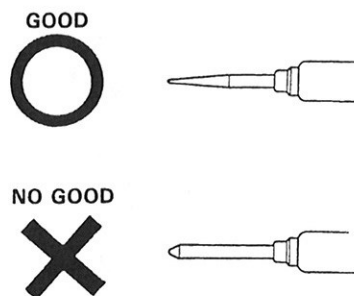
- When using the Service Tester, follow the manufacturer's instructions and those described in the Shop Manual.



- Always insert the probe of the tester from the wire harness side (except water proof connectors).



- Make sure to use the probe with a taper tip.



- Do not drop parts.



Symbol Marks

The following symbols stand for:



: Apply engine oil.

1, 2, 3,

①, ②, ③, : Sequence for removal or installation

Abbreviations

A/C	Air Conditioner
EACV	electronic Air Control Valve
L.	Left
PCV VALVE	Positive Crankcase Ventilation Valve
R.	Right
TA	Intake Air Temperature
TDC	Top Dead Center
TW	Coolant Temperature

Timing Belt

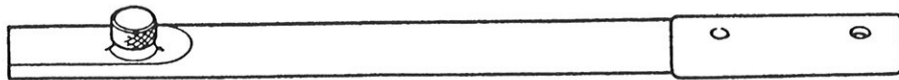
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Special Tools

Ref. No.	Tool Number	Description	Q'ty	Remarks
①	07JAB-0010000	Crank Pulley Holder Set	1	
①-1	07JAA-0010200	Socket Wrench 19 mm	1	
①-2	07JAB-0010200	Handle	1	
②	07JAB-0010400	Pulley Holder Attachment HEX 50 mm	1	
③	07744-0010400	Pin Driver	2	



①-1



①-2



②



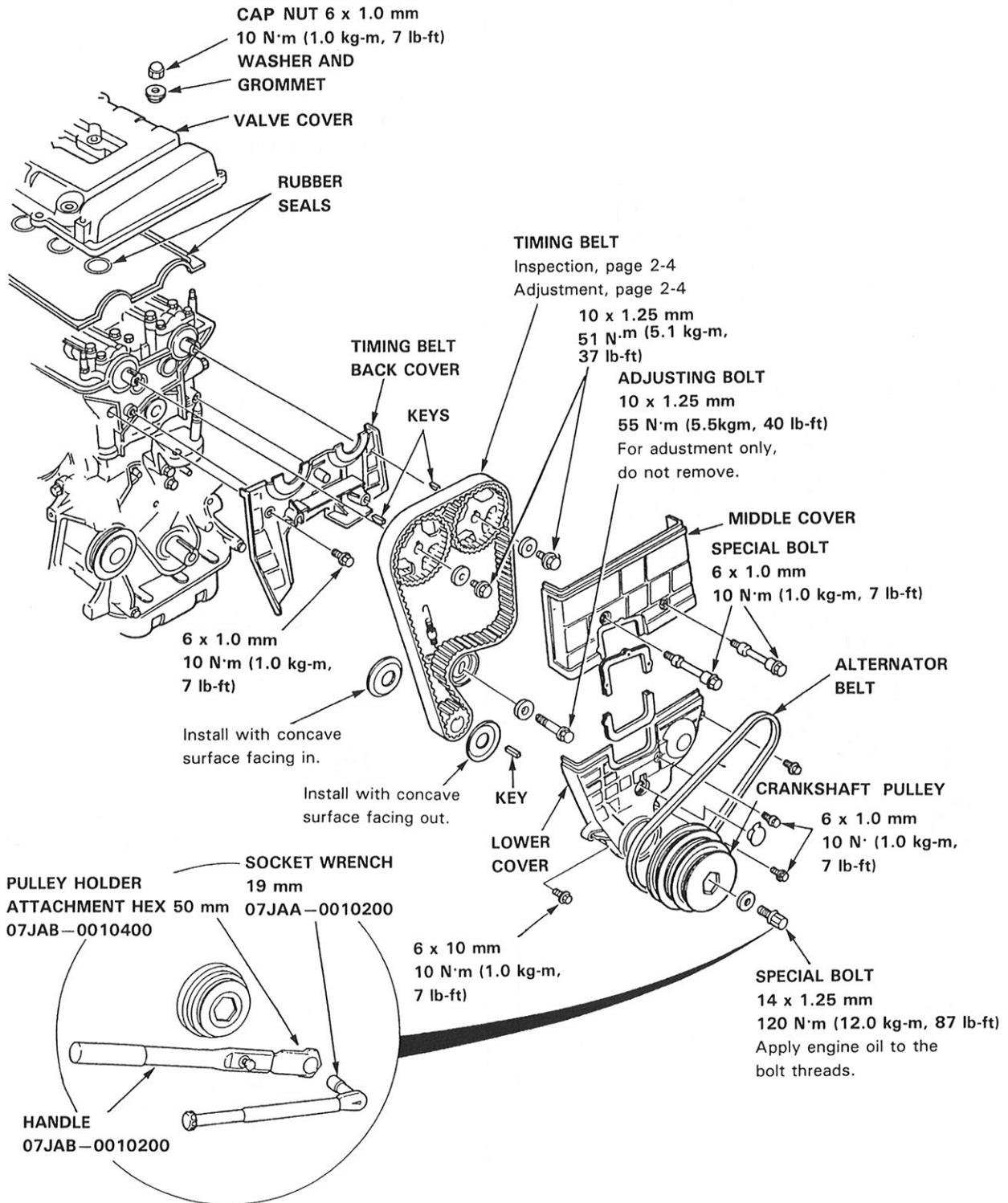
③

Timing Belt

Illustrated Index

NOTE

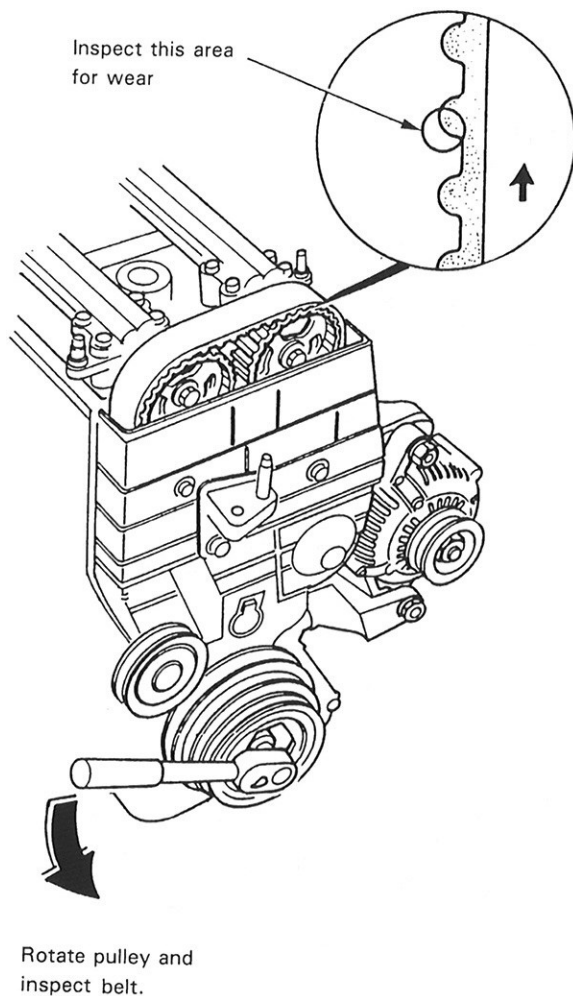
- Refer to page 2-7 for positioning crank and pulley before installing belt.
- Refer to page 3-39 for alternator belt adjustment.
- Refer to page 3-40 for A/C compressor belt adjustment.
- Mark direction of rotation before removing.



Timing Belt

Inspection

1. Remove the ignition wire cover and the ignition wire (page 3-16).
2. Remove the valve cover.
3. Inspect the timing belt for crack and soaking.
NOTE:
 - Replace the belt if oil soaked.
 - Remove any oil or solvent that gets on the belt.



4. If the pulley bolt loosens while turning the crank, retorque it to 120 N·m (12.0 kg-m, 87 lb-ft).

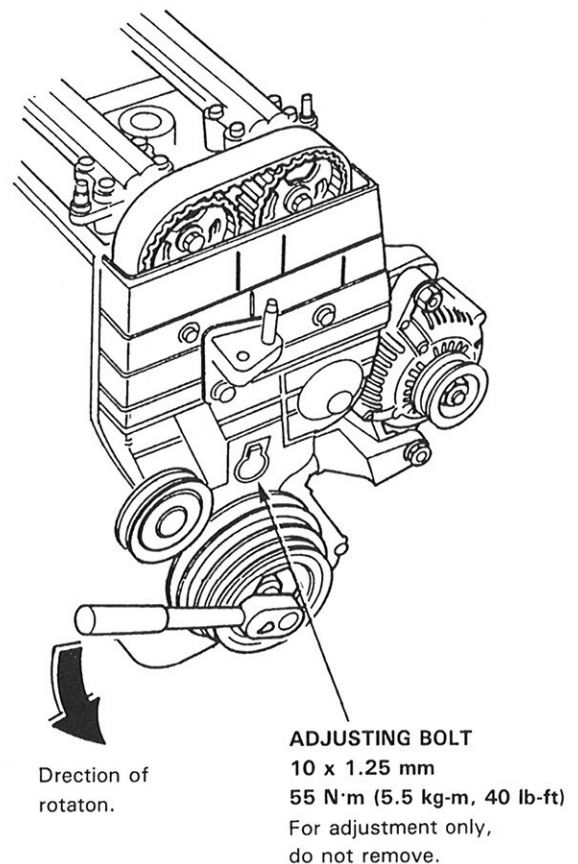
Tension Adjustment

CAUTION: Always adjust timing belt tension with the engine cold.

NOTE:

- Tensioner is spring-loaded to apply proper tension to the belt automatically after making the following adjustment.

1. Remove the ignition wire cover and the ignition wire (page 3-16).
2. Remove the valve cover.
3. Set the No.1 piston at TDC (page 2-7).
4. Loosen the adjusting bolt.



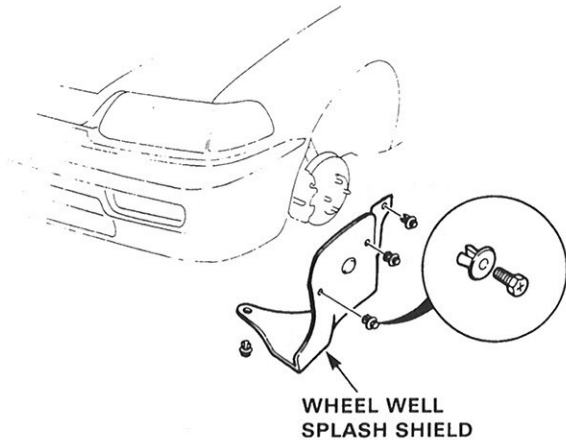
5. Rotate the crankshaft counterclockwise 3-teeth on the camshaft pulley to create tension on the timing belt.
6. Tighten the adjusting bolt.
7. If the pulley bolt loosens while turning the crank, retorque it to 120 N· (12.0 kg-m, 87 lb-ft).

Replacement

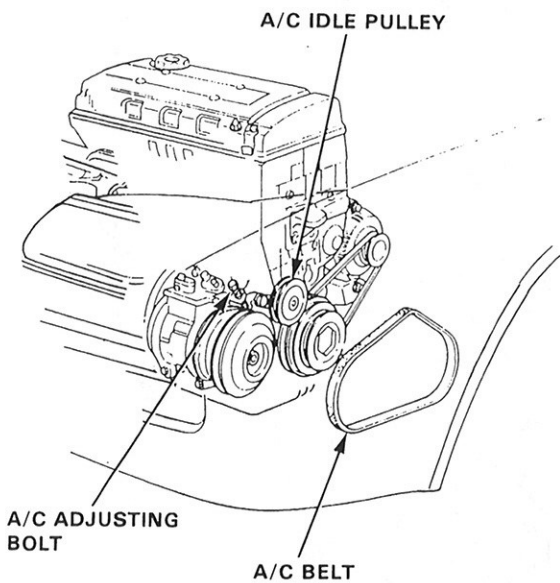
NOTE:

- Set the No.1 piston at TDC (page 5-45) before remove the timing belt.
- Inspect the water pump (page 5-77) after remove the timing belt.

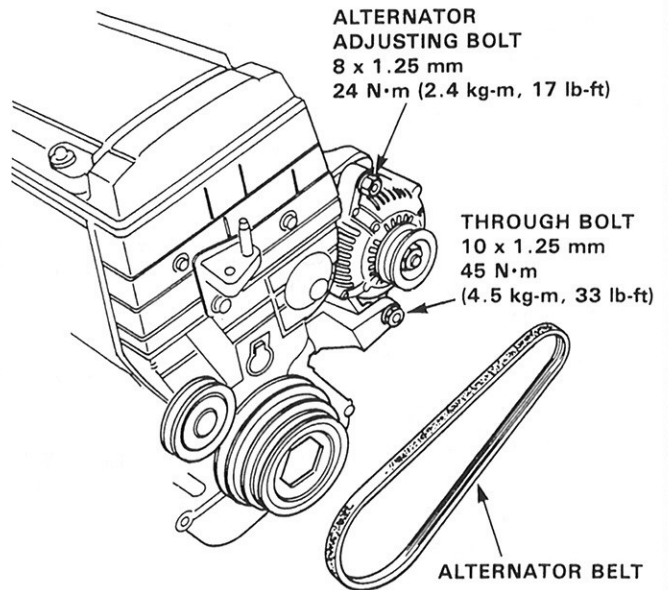
1. Remove the wheel well splash shield.



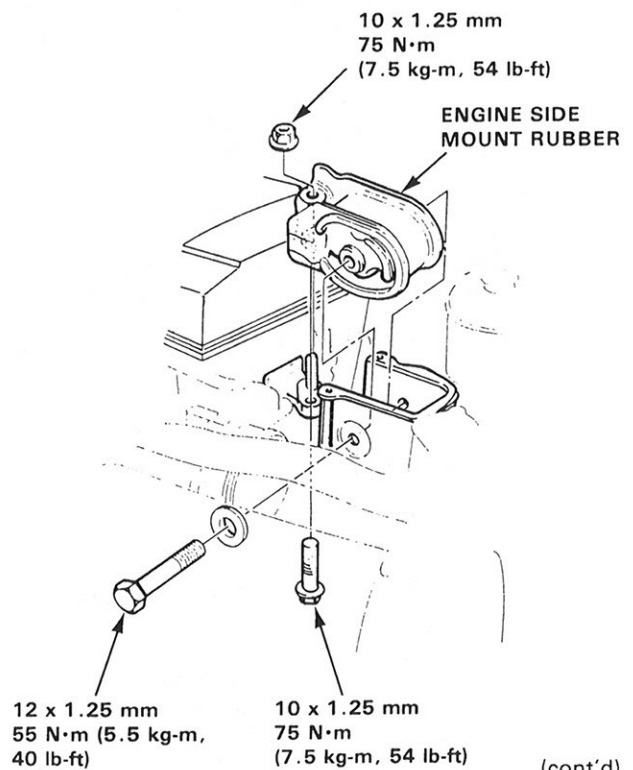
2. Loosen the air conditioner (A/C) adjusting bolt and idle pulley bolt, then remove the A/C belt.



3. Loosen the alternator adjusting bolt and through bolt, then remove the belt.



4. After installation, adjust the tension of each belt.
 - See page 3-39 for alternator belt tension adjustment.
 - See page 3-40 for A/C compressor belt tension adjustment.
5. Remove the engine support bolts and nut, then remove the side mount rubber.

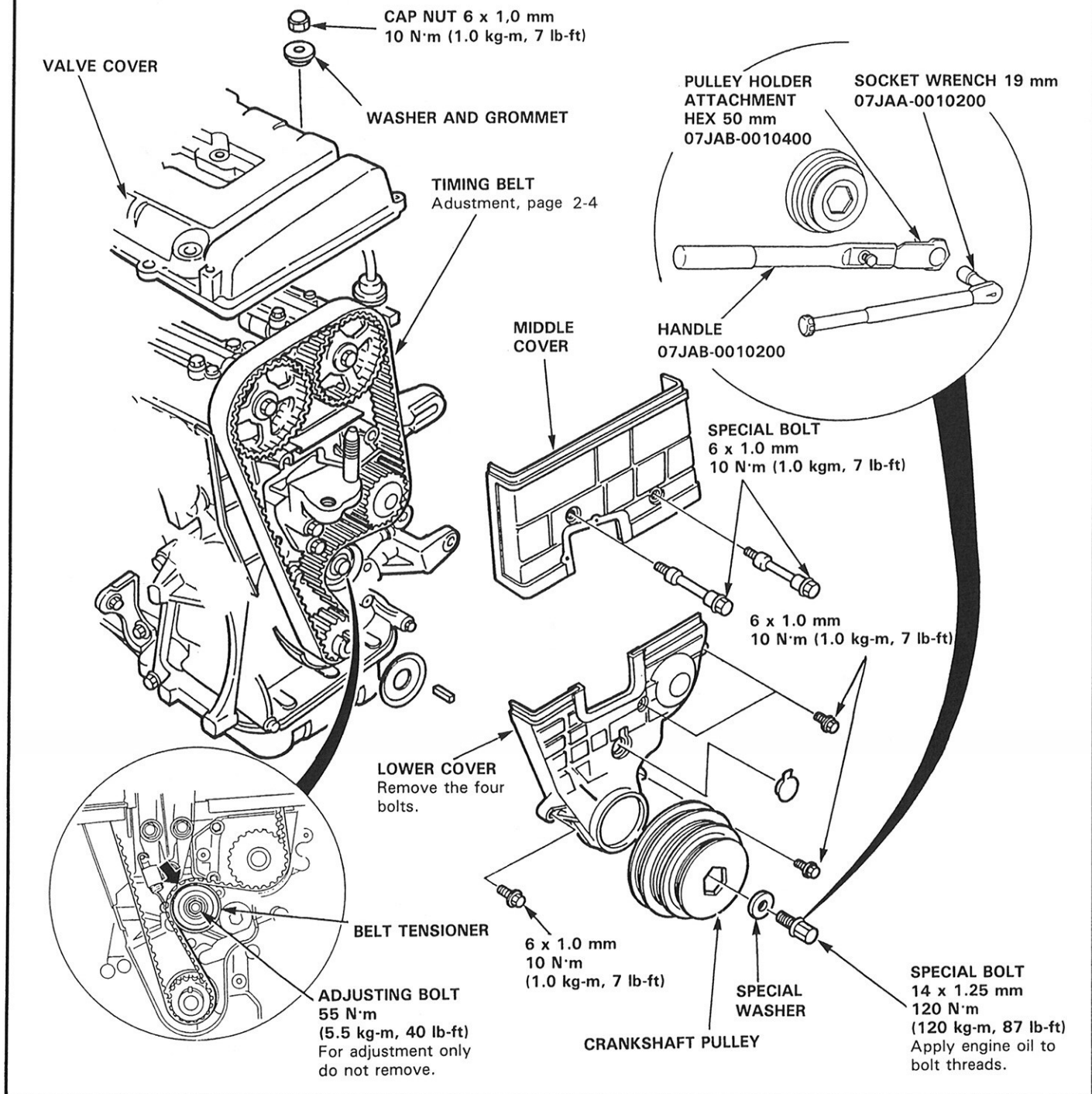


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Timing Belt

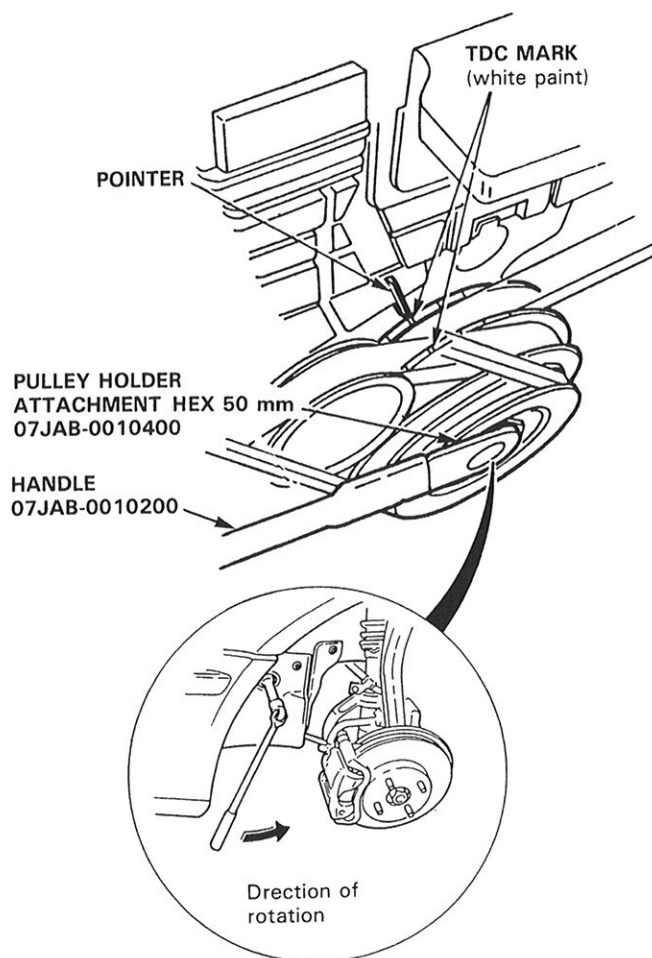
Replacement (cont'd)

6. Remove the ignition wire cover and ignition wire (page 3-16).
7. Remove the valve cover.
8. Remove the timing belt middle cover.
9. Remove the crankshaft pulley with the special tools.
10. Remove the timing belt lower cover.
11. Loosen the adjusting bolt, then remove the timing belt.
12. Install in the reverse order of removal; adjust the valve timing.
13. Carry out timing belt tension adjustment (page 2-4).



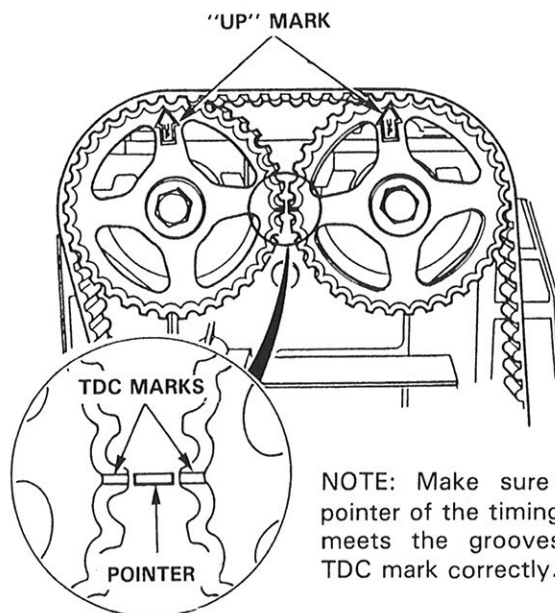
Positioning Crankshaft Before Installing Timing Belt

1. Remove the ignition wire cover and ignition wire (page 3-16).
2. Remove the valve cover.
3. Rotate the crankshaft with special tools, then set the No.1 piston at TDC.



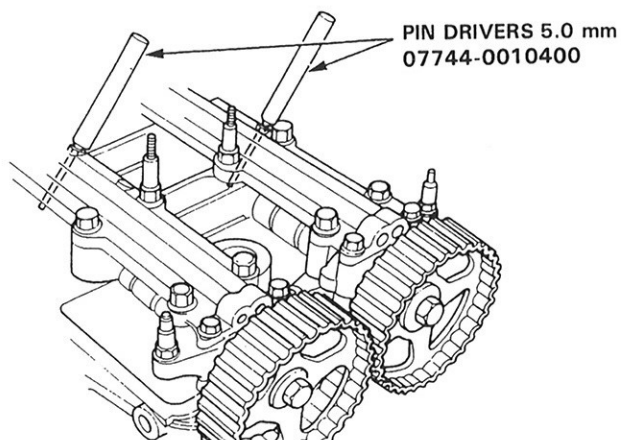
NOTE: If the pulley bolt loosens while turning the crank, retorque it to 120 N·m (12.0 kg-m, 87 lb-ft).

4. Make sure that the camshaft, pulleys are at the compression top dead center of the No.1 piston.



NOTE: Make sure the pointer of the timing belt meets the grooves of TDC mark correctly.

5. If the camshaft pulleys are not positioned at the compression top dead center of the No. 1 piston, remove the timing belt and adjust the position in following procedure, then reinstall the timing belt.
 - Refer to page 2-5 for removal and reinstallation of the timing belt.
 - Bring the "UP" marks of the camshaft pulleys to the top, and adjust the pointer of the timing belt back cover to the groove of the TDC mark on the pulleys.
 - Adjust the holes on the camshaft holder to the camshaft holes, insert pin driver of 5.0 mm diameter and fix them at the top dead center.
 - Remove the pin drivers after the belt has been reinstalled.



Cylinder Head/Valve Train

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Standard and Service Limits

Unit: mm (in)

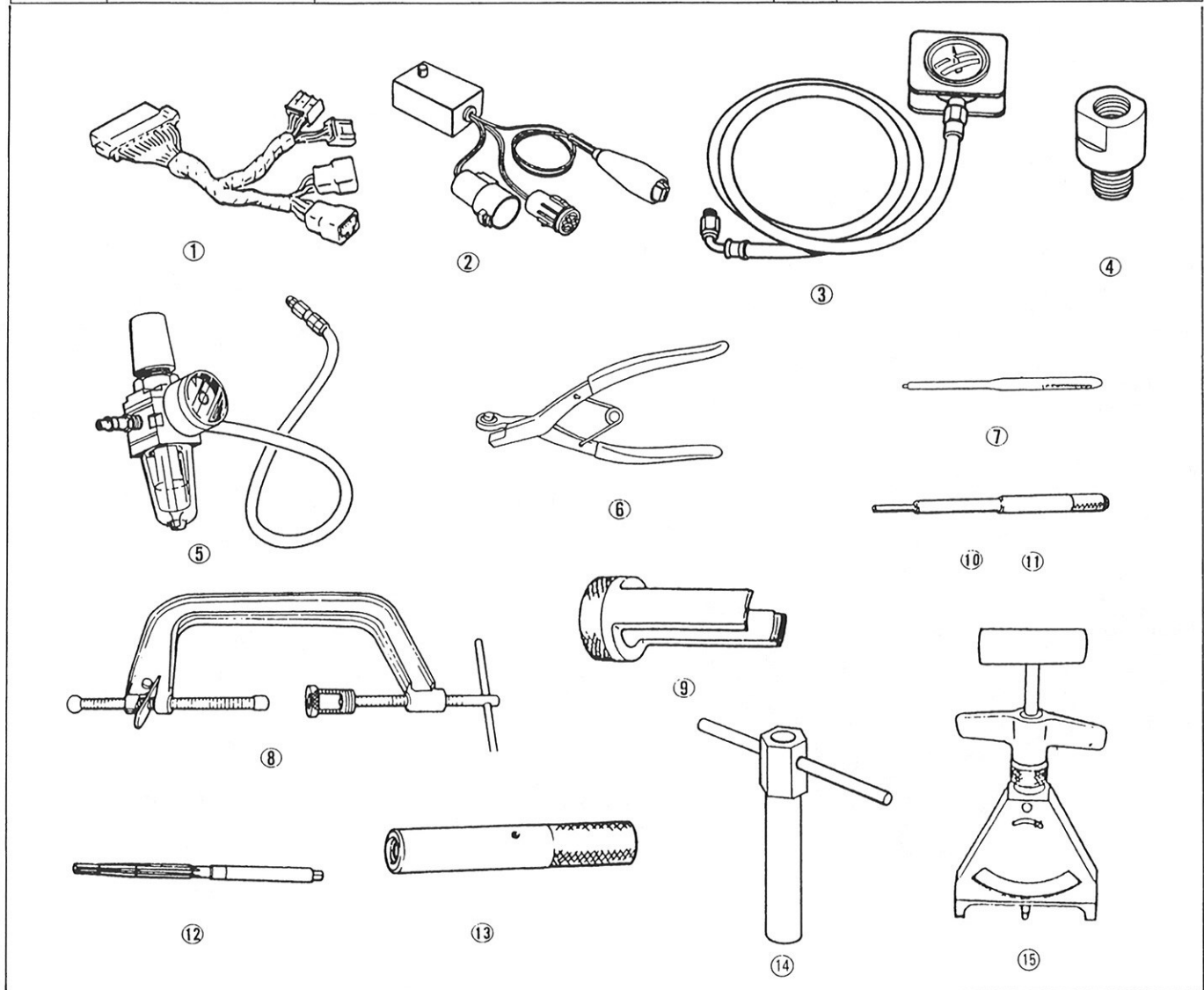
	MEASUREMENT		STANDARD (NEW)	SERVICE LIMIT
Compression	250 min ⁻¹ (rpm) and wide-open throttle	Nominal Minimum Maximum variation	— — —	1,275 kPa (13.0 kg/cm ² 185 psi) 932 kPa (9.5 kg/cm ² 135 psi) 196 kPa (2 kg/cm ² , 28 psi)
Cylinder head	Warpage Height		— 141.95–142.05 (5.589–5.593)	0.05 (0.002) —
Camshaft	End play Oil clearance Runout Cam lobe height	IN Primary Mid Secondary EX Primary Mid Secondary	0.05–0.15 (0.002–0.006) 0.050–0.089 (0.002–0.004) 0–0.015 (0–0.0006) 33.088 (1.3027) 36.267 (1.4278) 34.987 (1.3774) 32.785 (1.2907) 35.720 (1.4063) 34.691 (1.3658)	0.05 (0.02) 0.15 (0.006) 0.03 (0.0012) — — — — — —
Valve	Valve clearance Valve stem O.D. Stem-to-guide clearance	IN EX IN EX IN EX	0.15–0.19 (0.0059–0.0075) 0.17–0.21 (0.0067–0.0083) 5.475–5.485 (0.2156–0.2159) 5.450–5.460 (0.2146–0.2150) 0.035–0.045 (0.0014–0.0018) 0.050–0.080 (0.0020–0.0031)	— — 5.445 (0.2144) 5.420 (0.2134) 0.075 (0.0030) 0.120 (0.0047)
Valve seat	Width Stem installed height	IN and EX IN EX	1.25–1.55 (0.049–0.061) 37.465–37.935 (1.4750–1.4935) 37.165–37.635 (1.4632–1.4817)	2.0 (0.08) 38.185 (1.5033) 37.885 (1.4915)
Valve spring	Free length	IN Outer Inner EX	40.70 (1.6024)*1 40.71 (1.6028)*2 36.70 (1.4449)*1 36.74 (1.4465)*2 41.65 (1.6400)*1 41.64 (1.6394)*2	} 39.61 (1.5594) } 35.69 (1.4051) } 40.63 (1.5596)
Valve guide	I.D. Installed height	IN and EX IN and EX	5.51–5.53 (0.2169–0.2177) 12.55–13.05 (0.4941–0.5138)	5.53 (0.2177) 13.30 (0.5236)
Rocker arm	Arm-to-shaft clearance	IN and EX	0.025–0.052 (0.0010–0.0020)	0.080 (0.0031)

*1: NIPPON HATSUJO made

*2: CHUO HATSUJO made

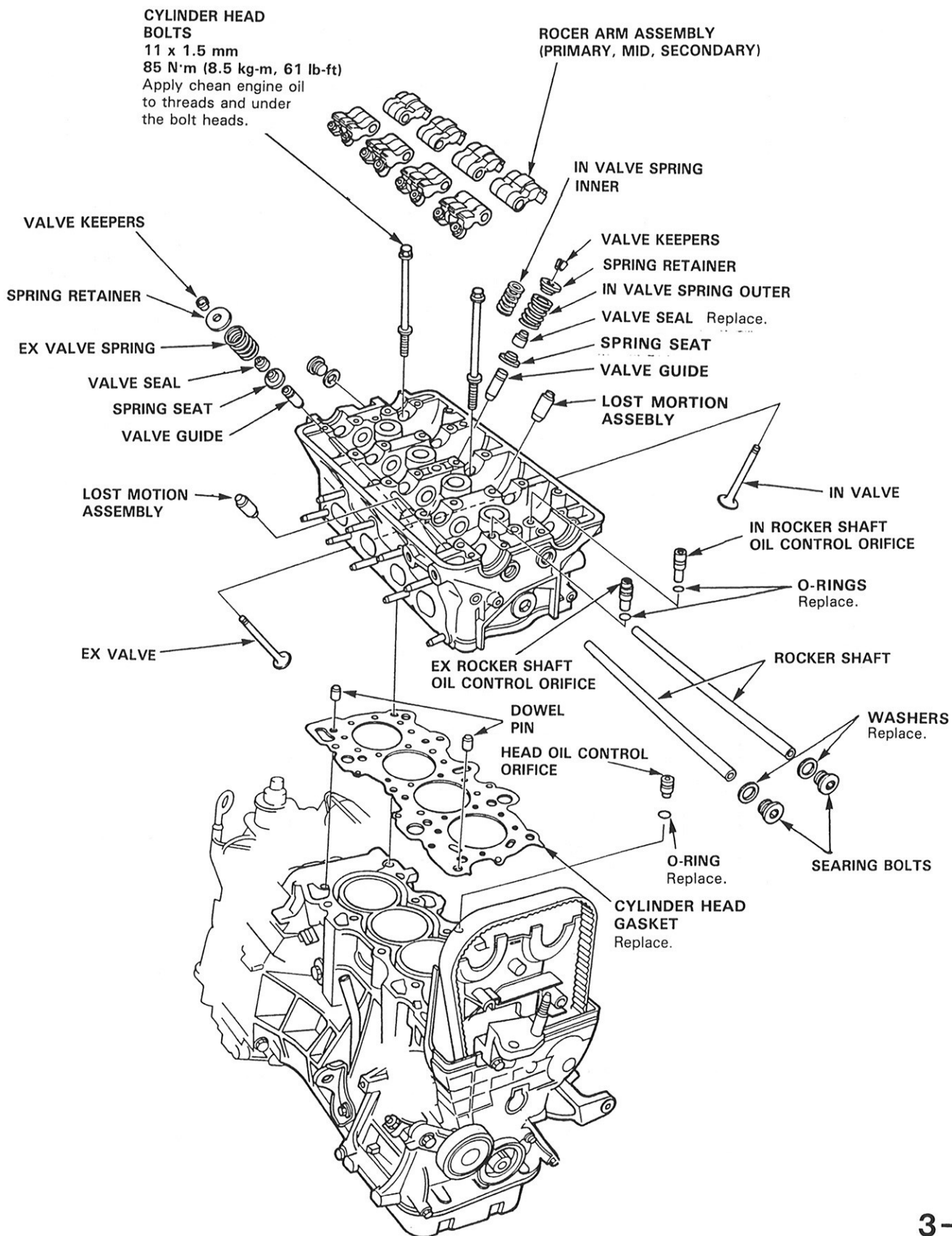
Spesical Tools

Ref. No.	Tool Number	Description	Q'ty	Remarks
①	07999-PD6000A	PGM-FI Test Harness	1	
②	07JAZ-SH20100	R.P.M. Connecting Adapter	1	
③	07406-0070000	Low Pressure Gauge	1	
④	07LAK-PR30100	Gauge Joint Adaptor	1	New tool
⑤	07LAJ-PR30100	Valve Inspection Set	1	New tool
⑥	07LAJ-PR30200	Air Stopper	1	New tool
⑦	07744-0010400	Pin Driver, 5.0 mm	2	
⑧	07757-0010001	Valve Spring Compressor	1	
⑨	07757-PJ10200	Valve Spring Compressor Attachment	1	
⑩	07742-0010100	Valve Guide Remover, 5.5 mm	1	
⑪	07942-8920000	Valve Guide Driver, 5.0 mm	1	
⑫	07HAH-PJ70100	Valve Guide Reamer, 5.5 mm	1	
⑬	07HAD-PJ70200	Stem Seal Driver	1	
⑭	07LAA-PR30100	Tappet Adjusting Wrench	1	New tool
⑮	07JGG-0010100	Belt Tension Gauge	1	



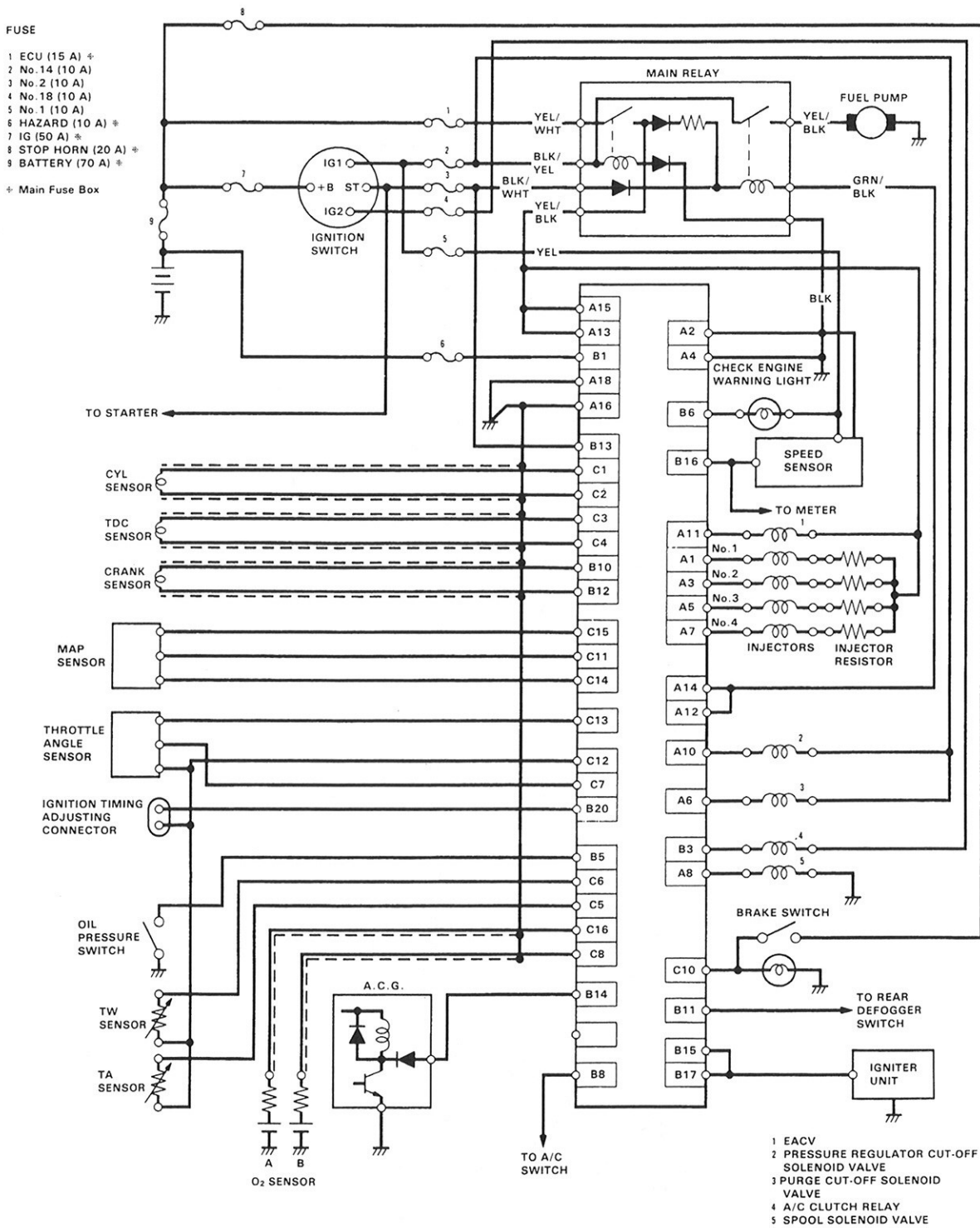


Prior to reassembling, clean all the parts in solvent, dry them and apply lubricant to any contact parts.



Variable Valve Timing and Lift Electronic Control System

Electrical Connections

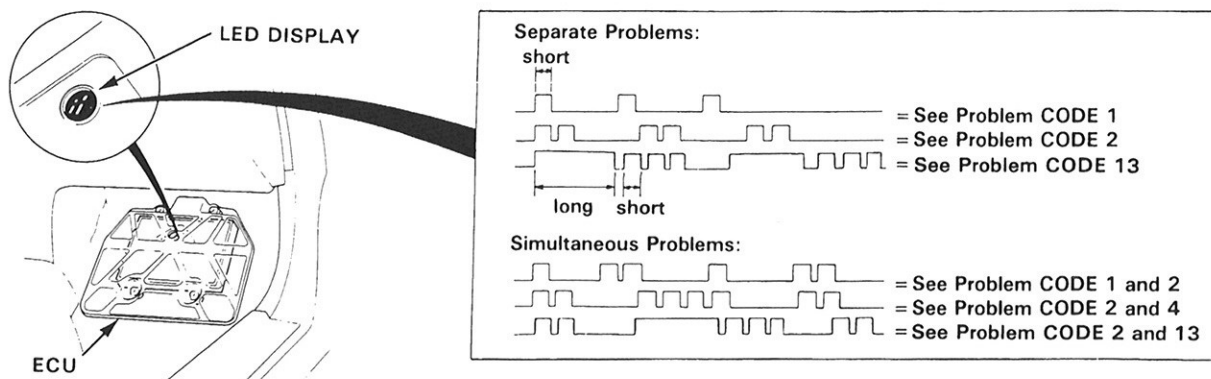


Variable Valve Timing and Lift Electronic Control System

Troubleshooting Self-diagnostic Procedure

When the Check Engine warning light has been reported on, turn the ignition on, pull down the passenger's side carpet from under the dashboard and observe the LED on the top of the ECU. The LED indicates a system failure code by blinking frequency. The ECU LED can indicate any number of simultaneous component problems by blinking separate codes, one after another. Problem codes 1 through 9 are indicated by individual short blinks. Problem codes 10 through 22 are indicated by a series of long and short blinks. One long blink equals 10 short blinks. Add the long and short blinks together to determine the problem code.

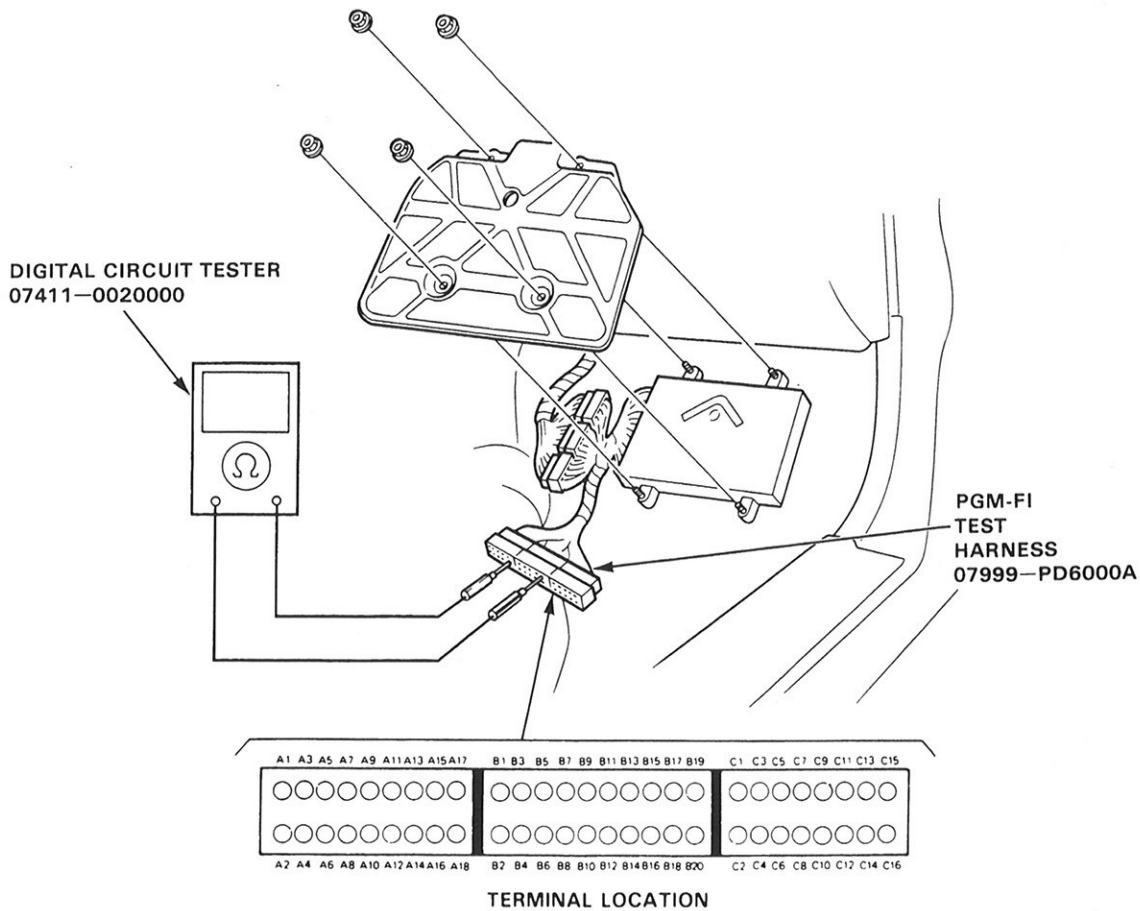
NOTE: Information on this page is for LH and RH models.



SELF-DIAGNOSIS INDICATOR BLINKS	SYSTEM INDICATED	PAGE
0	ECU	—
1, 2	OXYGEN CONTENT	—
3	MANIFOLD ABSOLUTE PRESSURE	—
5		—
4	CRANK ANGLE	—
6	COOLANT TEMPERATURE	—
7	THROTTLE ANGLE	—
8	TDC POSITION	—
9	No. 1 CYLINDER POSITION	—
10	INTAKE AIR TEMPERATURE	—
13	ATMOSPHERIC PRESSURE	—
14	ELECTRONIC AIR CONTROL	—
15	IGNITION OUTPUT SIGNAL	—
17	VEHICLE SPEED SENSOR	—
21	SPOOL SOLENOID VALVE	3-10
22	OIL PRESSURE SWITCH	3-12
43, 44	FUEL SUPPLY SYSTEM (KX, KS, KG)	—

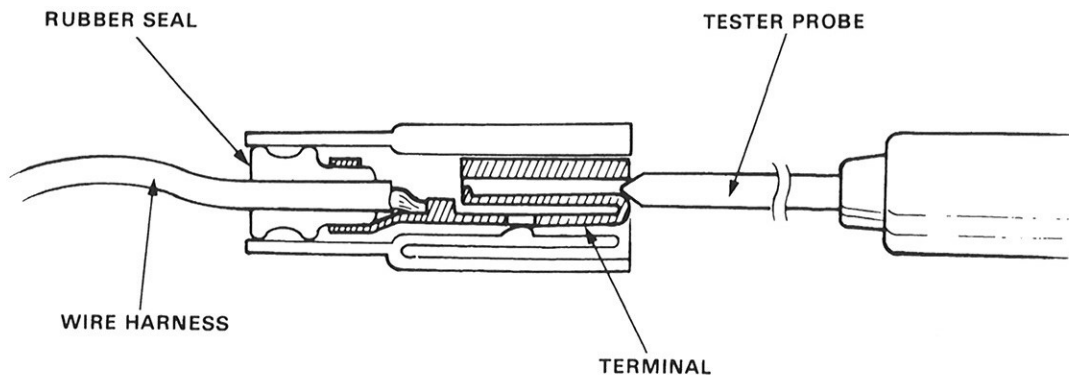
If codes other than those listed above are indicated, count the number of blinks again. If the indicator is in fact blinking unusual codes, substitute a known-good ECU led may come on, indicating a system problem, when, in fact, there is a poor or intermittent electrical connection. First, check the electrical connections, clean or repair connections if necessary. If the Check Engine warning light is on and LED stays on, replace the ECU.

If the inspection for a particular failure code requires the PGM-FI test harness, remove the right door sill molding, the small cover on the right kick panel, and pull the carpet back to expose the ECU. Unbolt the ECU bracket. Connect the PGM-FI test harness. Then check the system according to the procedure described for the appropriate code(s) listed on the following pages.
 NOTE: Information on this page is for LH and RH models.



CAUTION:

- Puncturing the insulation on a wire can cause poor or intermittent electrical connections.
- For testing at connectors other than the PGM-FI test harness, bring the tester probe into contact with the terminal from the connector side of wire harness connectors in the engine compartment. For female connectors, just touch lightly with the tester probe and do not insert the probe.



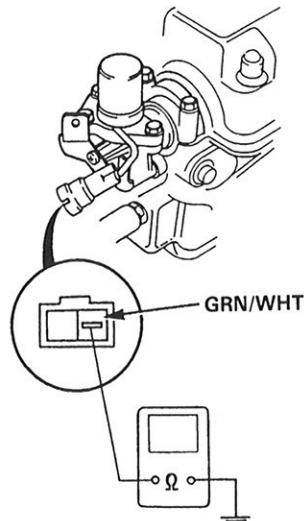
Variable Valve Timing and Lift Electronic Control System

Troubleshooting Flowchart — Spool Valve

 Self-diagnosis LED indicates code 21: A problem in the Spool Valve circuit.

Disconnect the 2P connector from the spool valve.

Check for continuity between GRN/WHT terminal and body ground.



Is there 14–30 Ω ?

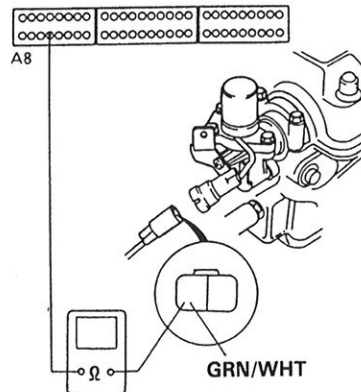
NO

Replace the spool solenoid valve.

YES

Connect the ECU test harness.

Check for continuity between GRN/WHT terminal and A 8 terminal.



Does continuity exist?

NO

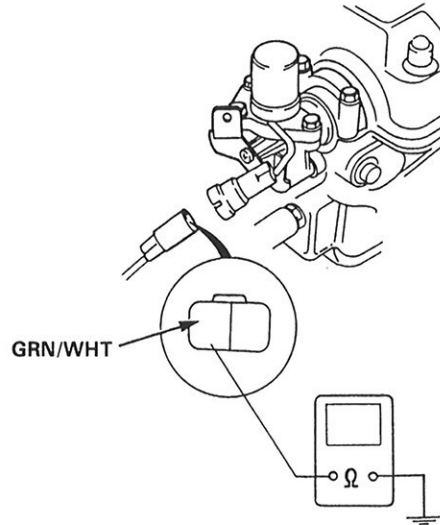
Repair open in GRN/WHT wire between ECU and spool valve connector.

YES

To page 3-11

From page 3-10

Check for continuity between GRN/
WHT terminal (harness side) and body
ground.



Does continuity exist?

YES

Repair short in GRN/WHT wire between
ECU and spool valve connector.

Subwstitute a known good ECU and
recheck. If symptom/indication goes
away replace the original ECU.

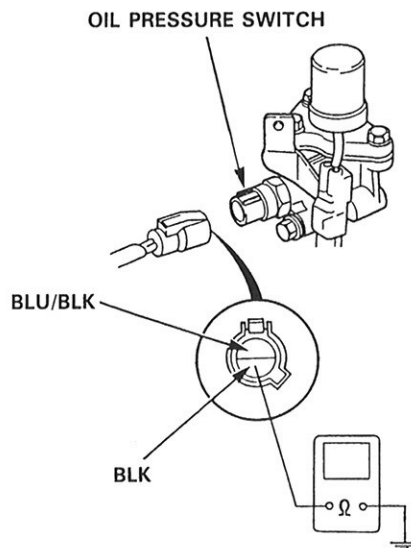
Variable Valve Timing and Lift Electronic Control System

Troubleshooting Flowchart — Oil Pressure Switch

 Self-diagnosis LED indicates code 22 : A problem Oil Pressure Switch circuit.

Disconnect the 2P connector from the oil pressure switch.

Check for continuity between BLK terminal and body ground.



Does continuity exist?

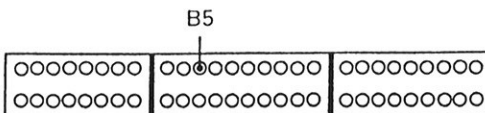
NO

Repair open in BLK wire between 2P connector and body ground.

YES

Connect the ECU test harness.

Check for continuity between BLU/BLK terminal and B5 terminal.



Does continuity exist?

NO

Repair open in BLU/BLK wire between ECU and 2P connector.

YES

To page 3-13

From page 3-12

Remove 10 mm sealing bolt and connect oil pressure gauge (for AT oil pressure test).

Connect a tachometer.

Start the engine and warm it up to normal operating temperature.

Check oil pressure at engine speeds of 1,000 min⁻¹ (rpm), 3,000 min⁻¹ (rpm) and 5,000 min⁻¹ (rpm).

Is pressure below 0.5 kg/cm²?

NO

Inspect the spool valve.

YES

Check for continuity between the 2 terminals on the oil pressure switch.

Replace oil pressure switch.

Does continuity exist?

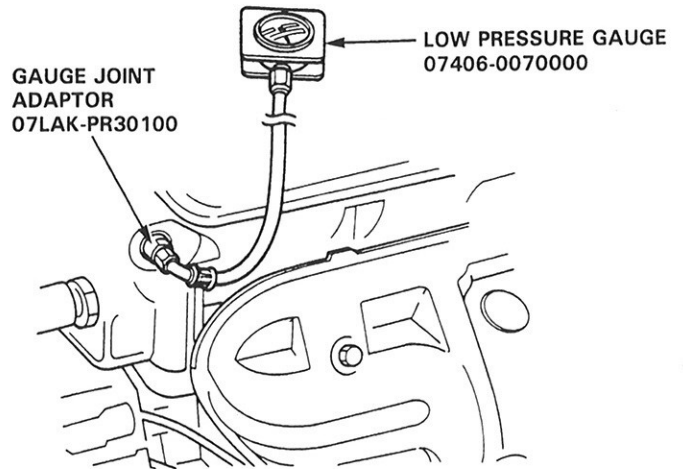
NO

YES

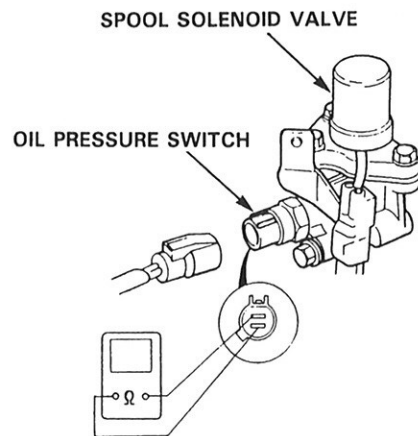
Disconnect the 2P connector from the spool solenoid valve

Attach the battery positive terminal to the GRN/WHT terminal.

To page 3-14



NOTE: Keep measuring time as short as possible because engine is running with no load (within one minute).

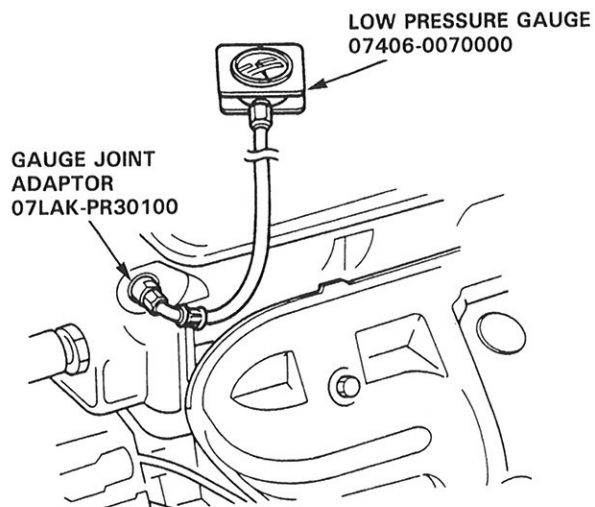


Variable Valve Timing and Lift Electronic Control System

Troubleshooting Flowchart — Oil Pressure Switch

From page 3-13

Start the engine and check oil pressure at engine speeds of 5,000 min⁻¹ (rpm).



NOTE: Keep measuring time as short as possible because engine is running with no load (within one minute).

Is pressure above 392 kPa
(4 kg/cm², 57 psi)

NO

Inspect the spool valve.

YES

Check for continuity between the 2 terminals on the oil pressure switch under above condition.

Does continuity exist?

NO

Replace oil pressure switch.

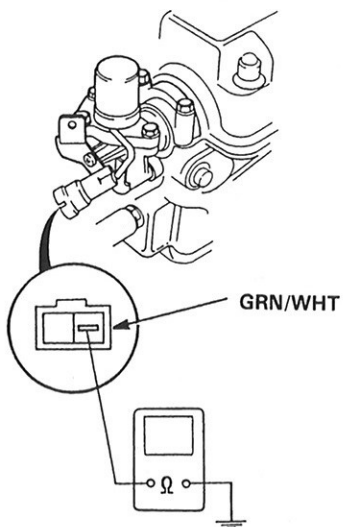
YES

Substitute a known-good ECU and recheck. If symptom/indication goes away, replace the original ECU.

Spool Valve Inspection

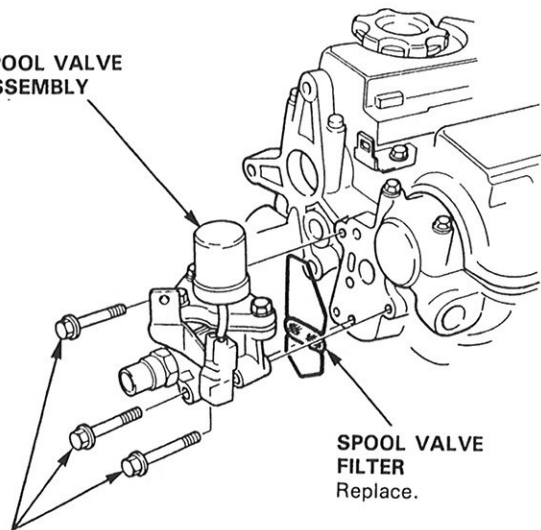
1. Disconnect the 2P connector from the spool solenoid valve.
2. Measure resistance between the GRN/WHT terminal and body ground.

Resistance: approx 14–30 ohms



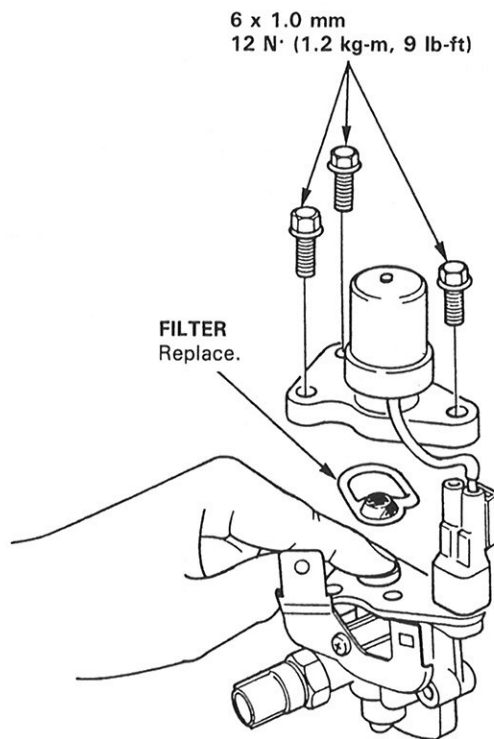
3. If the resistance is within specifications, remove the spool valve assembly from the cylinder head, and check the spool valve filter for clogging.
 - If there is clogging, replace the engine oil filter and the engine oil.

SPOOL VALVE ASSEMBLY



6 x 1.0 mm
12 N·m (1.2 kg-m, 9 lb-ft)

4. If filters are normal, push the spool valve with the finger and check its movement.
 - If spool valve is normal, check the engine oil pressure.



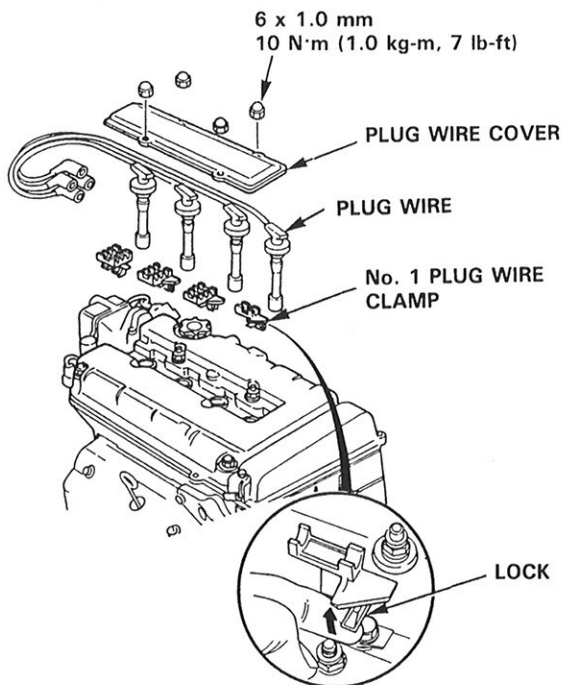
Cylinder Head

Removal

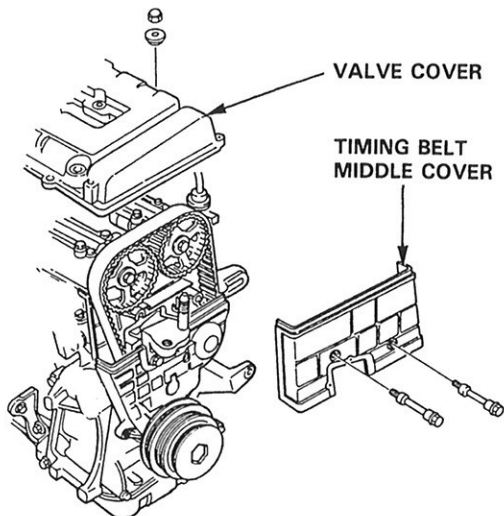
NOTE:

- Inspect the timing belt before removing the cylinder head.
- Turn the crankshaft so that the No. 1 cylinder is at top-dead-center (page 2-7).
- Mark all emissions hoses before disconnecting them.

1. Remove the plug wire cover and the plug wires.
2. Remove the plug wire clamps while pulling up on the lock.

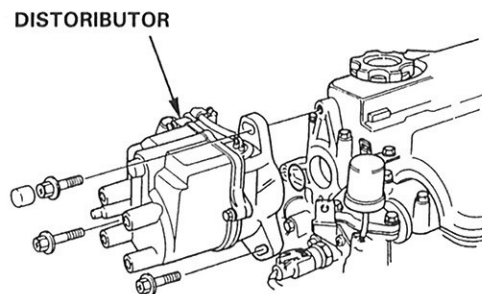


3. Remove the valve cover and the timing belt middle cover.

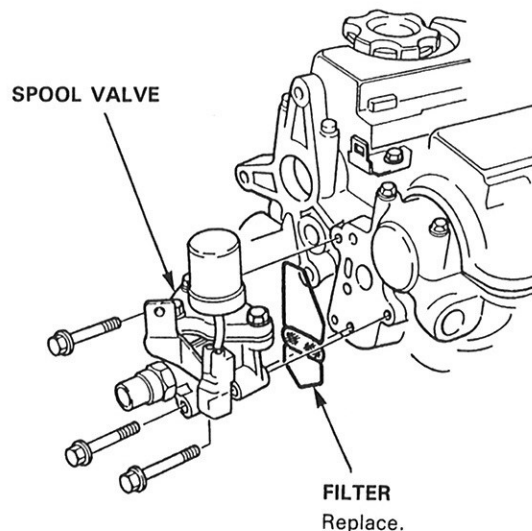


4. Disconnect the engine wire connectors and clamps from the cylinder head, throttle body, and IN/EX manifolds.
 - Ignition coil connector (from distributor)
 - EACV connector
 - Engine ground wire
 - Thermount connector
 - Coolant temperature (TW) sensor connector
 - Intake air temperature (TA) sensor connector.
 - Injection connector
 - TDC/CRANK sensor connector
 - Spool valve connector

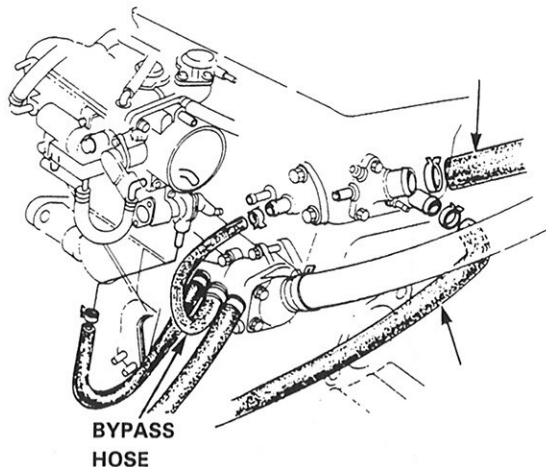
5. Remove the distributor.



6. Remove the spool valve.



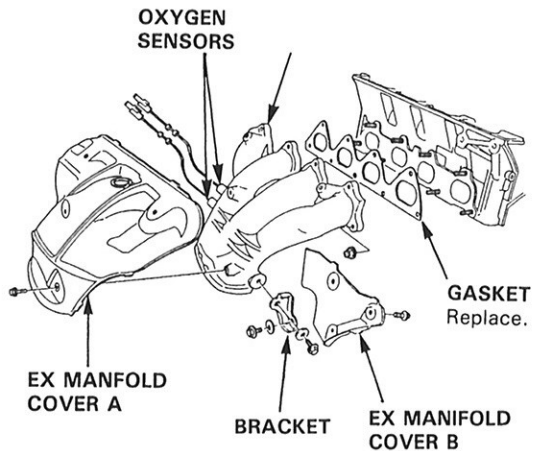
7. Remove the bypass hoses from the cylinder head and the intake manifold.



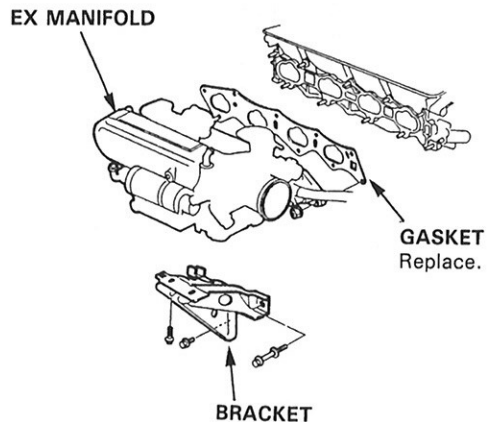
8. Remove the exhaust manifold, the covers and the bracket.

CAUTION:

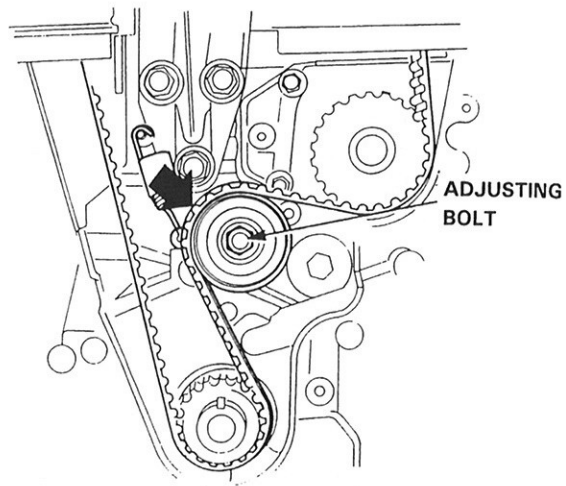
- Remove the oxygen sensors before removing the exhaust manifold.
- Do not use air wrench or hammer for removing the exhaust manifold, if the oxygen sensors are not to be removed.



9. Remove the intake manifold and the bracket.



10. Loosen the timing belt adjusting bolt, releasing the timing belt, and fix the bolt.

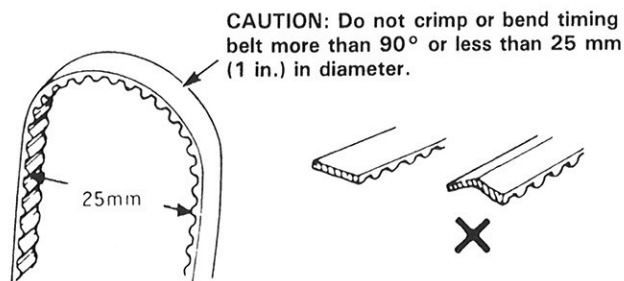


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Cylinder Head

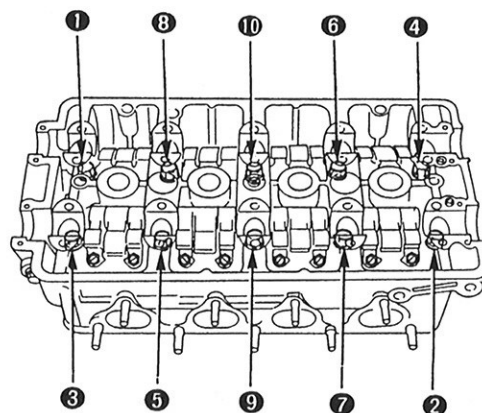
Removal (cont'd)

11. Remove the timing belt from the camshaft pulleys.

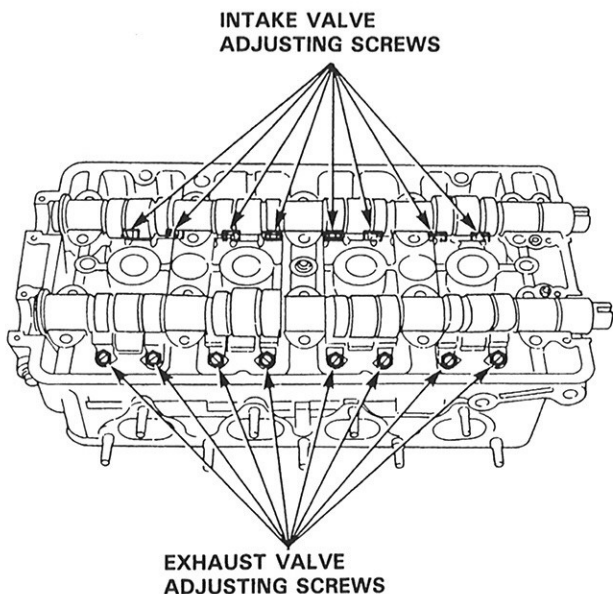


14. Loosen the cylinder head bolts, then remove the cylinder head.

NOTE: Loosen the bolts a criss-cross pattern in 2 or 3 steps, beginning with the outer nuts.



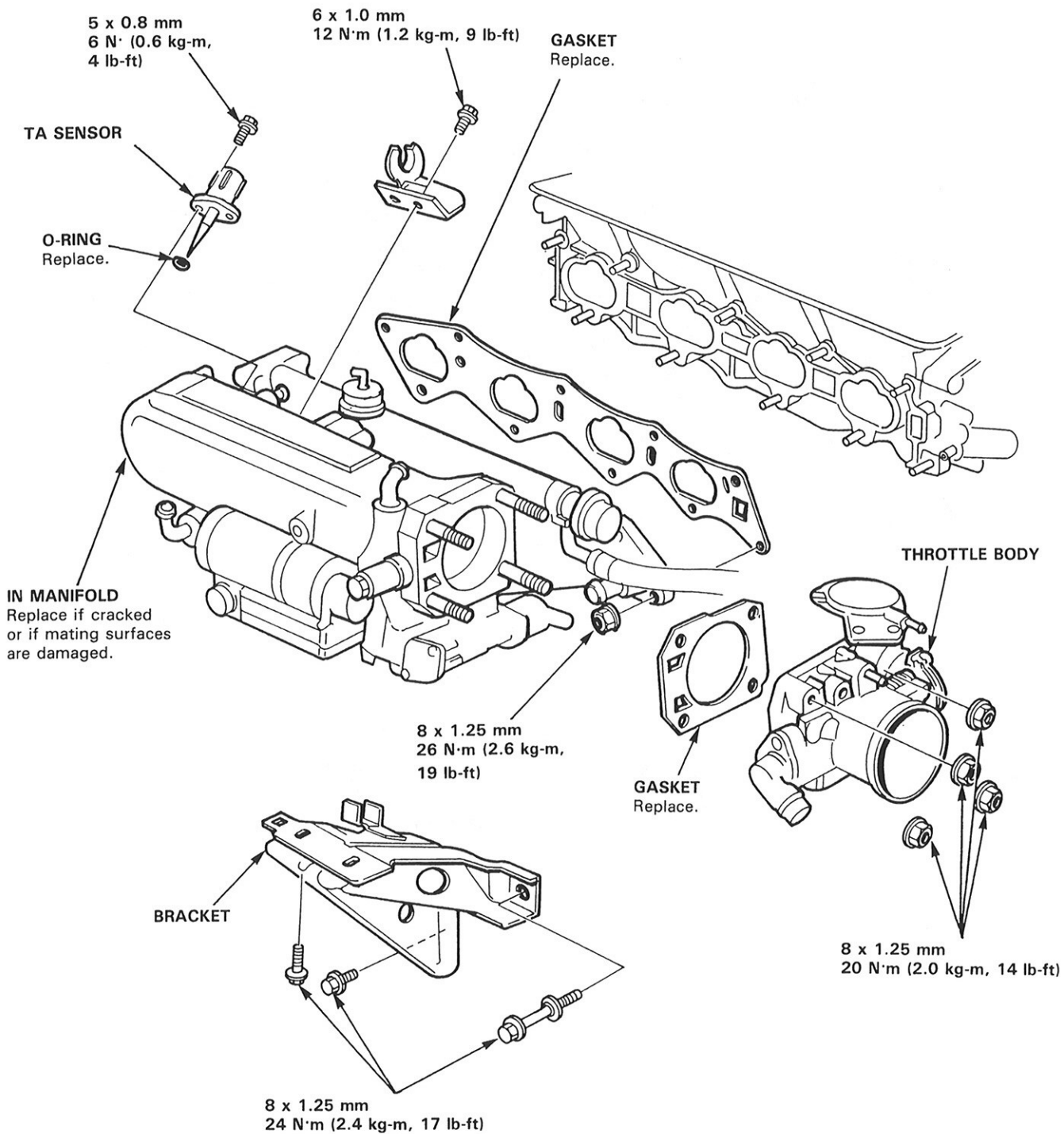
12. Loosen the valve adjusting screws.
13. Remove the camshaft holders, then remove the camshaft.



Intake Manifold

Replacement

NOTE: Use new O-rings and gaskets when reassembling.



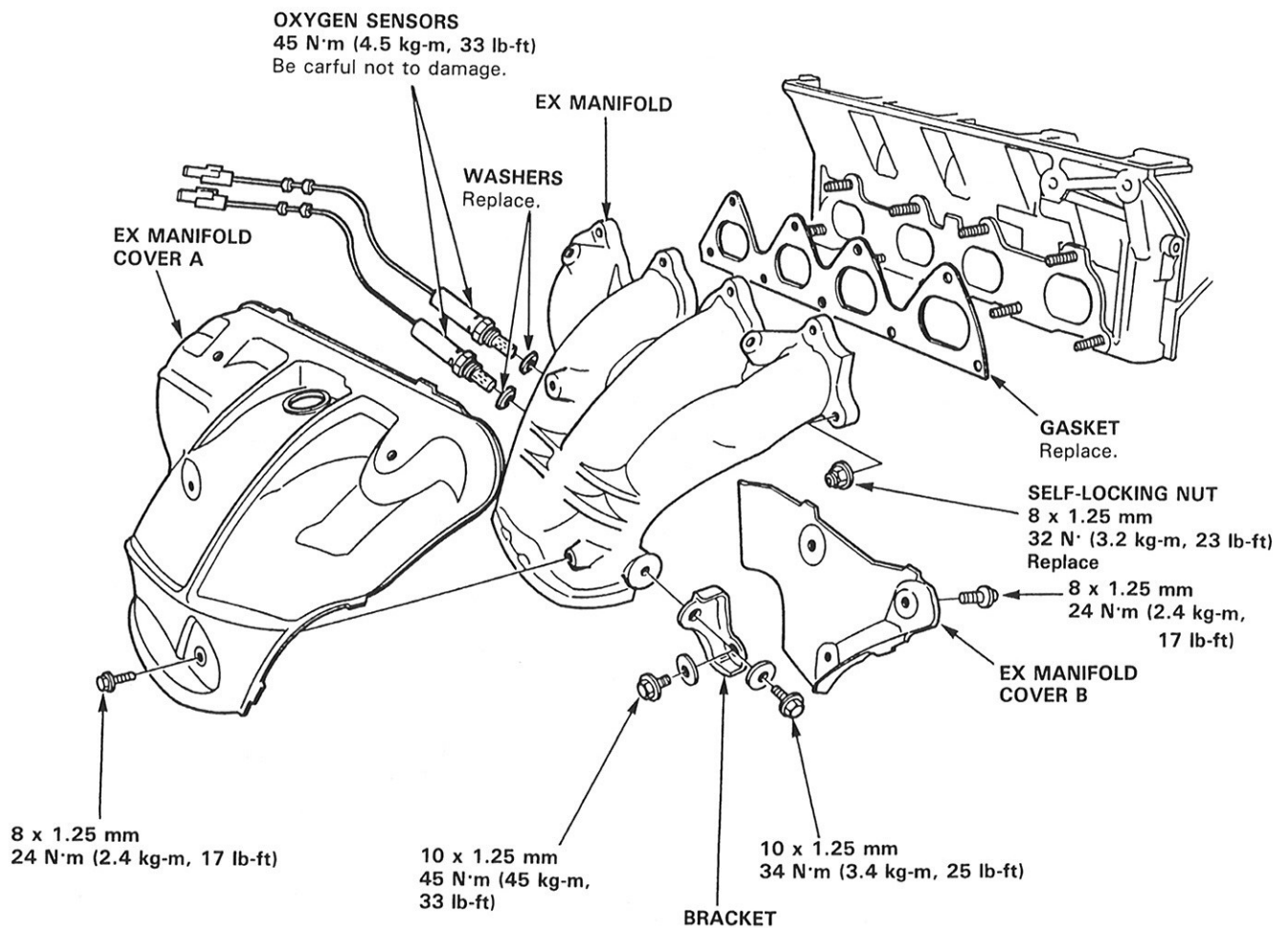
Exhaust Manifold

Replacement

CAUTION;

- Check for folds or scratches on the surface of the gasket. Replace with a new gasket if damaged.
- Remove the oxygen sensors before removing the exhaust manifold.
- Do not use air wrench or hammer for removing the exhaust manifold, if the oxygen sensors are not to be removed.
- Install the oxygen sensors after installing the exhaust manifold.
- Do not use air wrench for tightening self-locking nuts, if oxygen sensors are not to be removed.

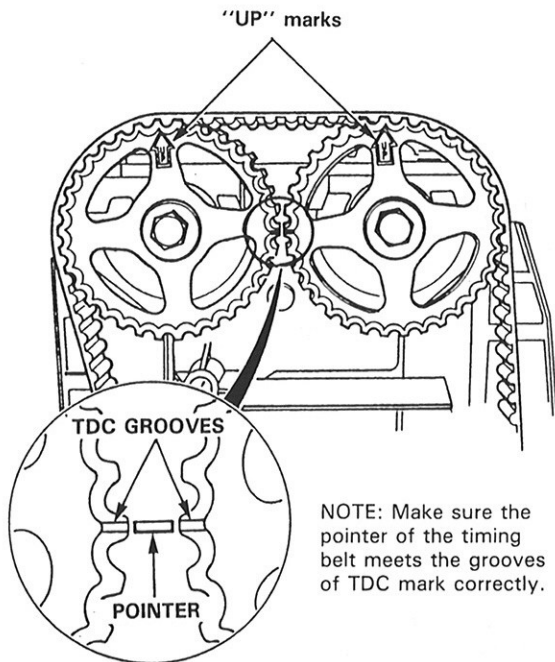
NOTE: Use new gaskets and self-locking nuts when reassembly.



Camshaft Pulleys

Removal

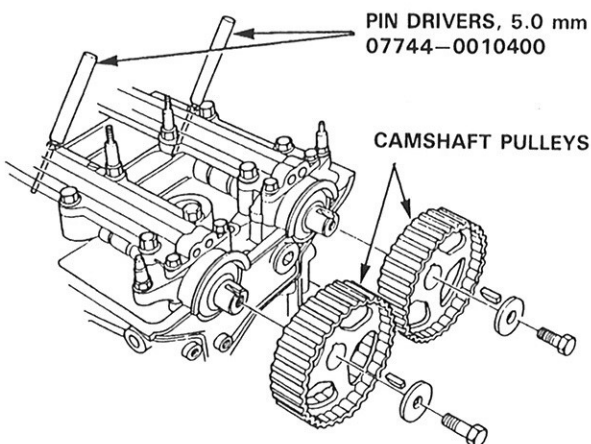
1. To ease reassembly, turn the pulley until the "UP" marks faces up, and the front timing marks re aligned with the both mark on the pulleys.



2. Remove the retaining bolts and washers, then remove the camshaft pulleys and keys.

NOTE

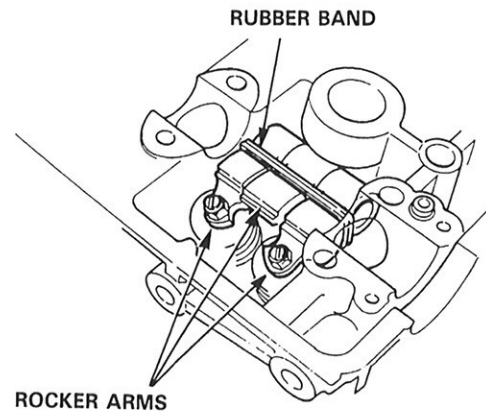
- Adjust the holes on the camshaft holder to the camshaft holes, insert pin driver of 5,0 mm diameter and fix them at the top dead center.
- Remove the pin drivers after the belt has been reinstalled.



Rocker Arms

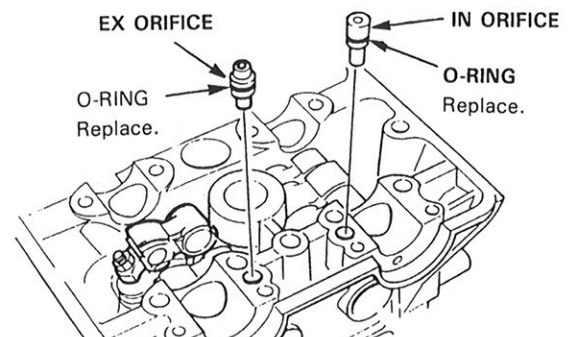
Removal/Inspection

1. Hold the rocker arms together with a rubber band to prevent them from separating.



2. Remove the intake and exhaust rocker shaft oil control orifice, then remove the spool valve and the sealing bolts.

NOTE: The shapes of the oil control orifice of the intake and exhaust are different. Identify the parts as they are removed to ensure reinstallation in the original locations.

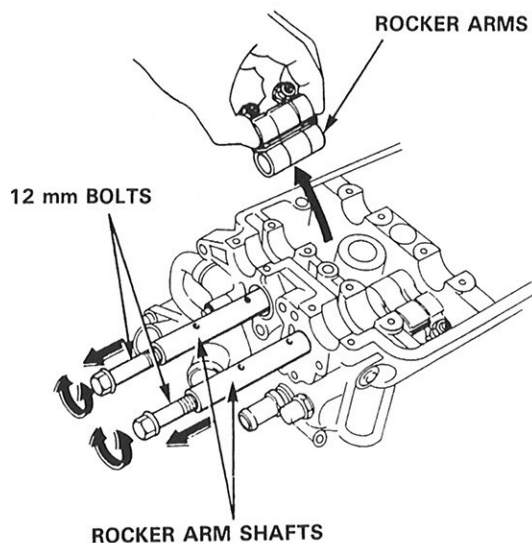


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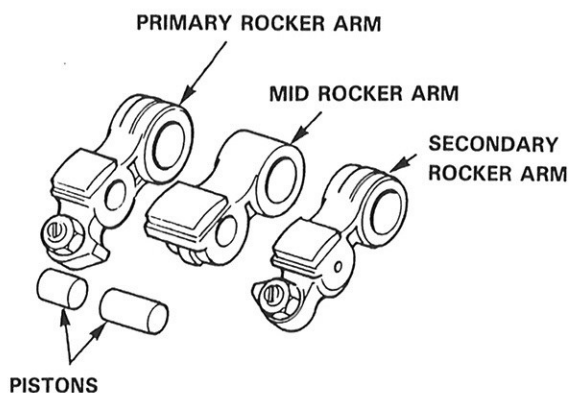
Rocker Arms

Inspection (cont'd)

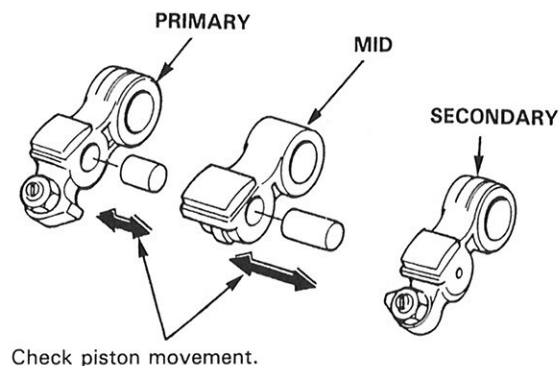
3. Screw 12 mm bolts into the rocker arm shafts. Remove each rocker arm while slowly pulling out of in take and exhaust rocker arm shafts.



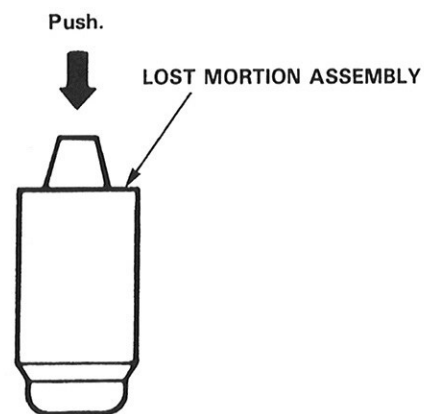
NOTE: When removing the primary rocker arm, carefully apply air pressure to the oil passage of the rocker arm.



4. Inspect the rocker arm piston. Push it manually. If it does not move smoothly, replace the rocker arm assembly.



5. Remove the lost motion assembly from the cylinder head and inspect it. Pushing it gently with the fingers will cause the front to sink slightly. Increasing the force on it will cause it to sink deeply. — If the lost motion assembly does not move smoothly, replace it.



Camshafts

Inspection

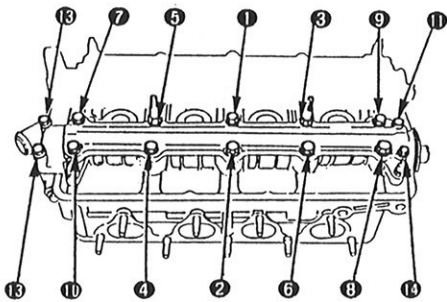
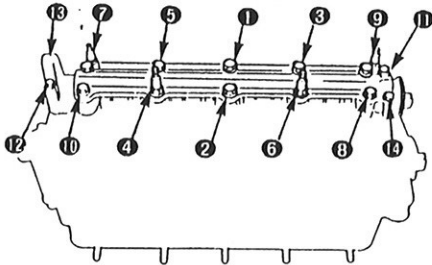
NOTE:

- Do not rotate the camshaft during inspection.
- Remove the rocker arms and rocker shafts.

1. Put the camshaft and cam holders on the cylinder head, and then tighten the bolts to the specified torque.

Specified torque.

- ① — ⑩ : 8 mm bolts 22 N·m (2.2 kg-m, 16 lb-ft)
- ⑪ — ⑭ : 6 mm bolts 11 N·m (1.1 kg-m, 8 lb-ft)

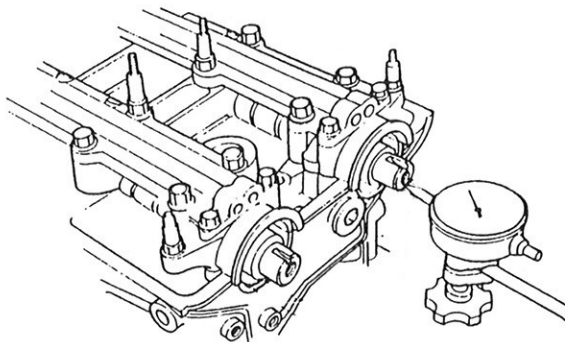


2. Seat the camshaft by pushing it toward distributor end of cylinder head.
3. Zero the dial indicator against end of distributor drive, then push the camshaft back and forth, and read the end play.

Camshaft End Play:

Standard (New): 0.05–0.15 mm
(0.002–0.006 in.)

Service limit: 0.5 mm (0.02 in.)



4. Remove the bolts, then remove the cam holders from the cylinder head.

– Lift camshaft out of cylinder head, wipe clean, then inspect lift ramps. Replace camshaft if lobes are pitted, scored, or excessively worn.

– Clean the camshaft bearing surfaces in the cylinder head, then set camshaft back in place.

– Insert plastigage strip across each journal.

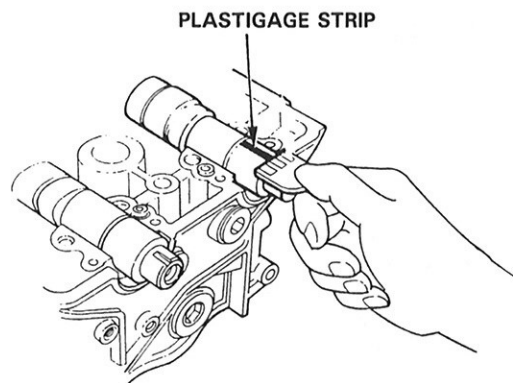
5. Put the camshaft on the cylinder head, then install the cam holders, and then tighten the bolts to the specified torque, as shown in the left column on this page.

6. Measure widest portion of plastigage on each journal.

Camshaft Bearing Radial Clearance:

Standard (New): 0.050–0.089 mm
(0.002–0.004 in.)

Service Limit: 0.15 mm (0.006 in.)



(cont'd)

Camshaft

Inspection (cont'd)

7. If camshaft bearing radial clearance is out of tolerance:

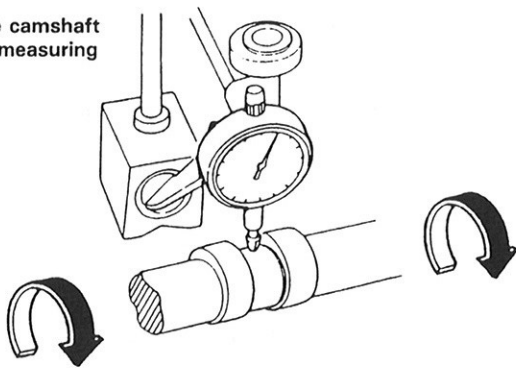
- And camshaft has already been replaced, you must replace the cylinder head.
- If camshaft has not been replaced, first check total runout with the camshaft supported on V-blocks.

Camshaft Total Runout:

Standard (New): 0.015 mm (0.0006 in)

Service Limit: 0.030 mm (0.0012 in)

Rotate camshaft while measuring

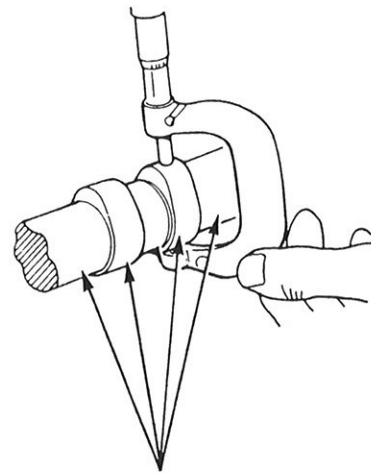


- If the total runout of the camshaft is within tolerance, replace the cylinder head.
- If the total runout is out of tolerance, replace the camshaft and recheck. If the bearing clearance is still out of tolerance, replace the cylinder head.

8. Check the wear of the cam lobe height.

Cam lobe height standard (New):

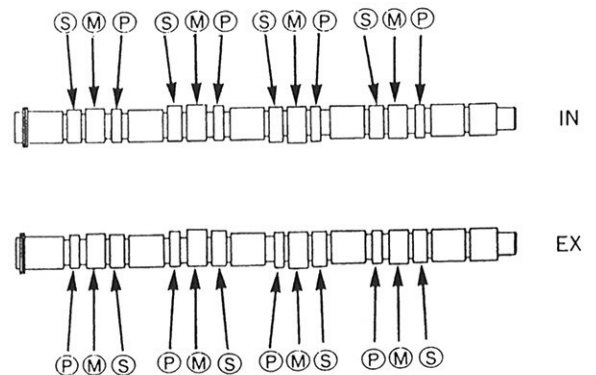
	INTAKE	EXHAUST
PRIMARY	33.088 mm (1.3027 in)	32.785 mm (1.2907 in)
MID	36.267 mm (1.4278 in)	35.720 mm (1.4063 in)
SECONDARY	34.978 mm (1.3774 in)	34.691 mm (1.3658 in)



Check this area for wear

Cam Position

Ⓟ : Primary Ⓜ : Mid Ⓢ : Secondary

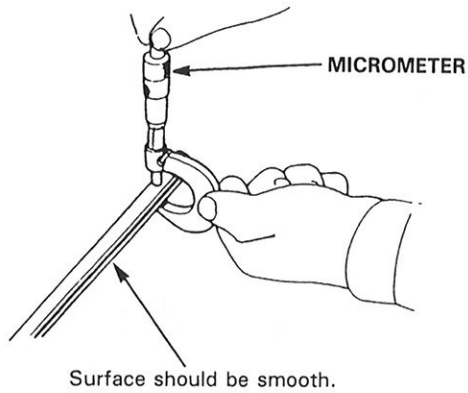


Rocker Arms and Shafts

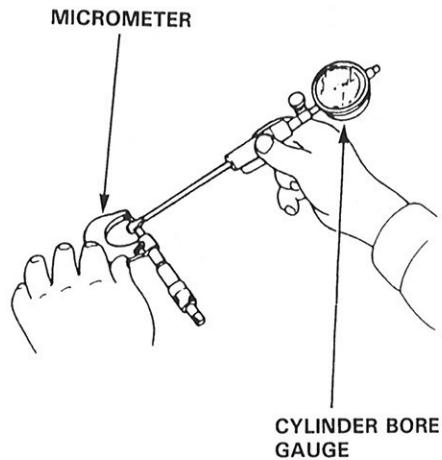
Clearance

Measure both the intake rocker shaft and exhaust rocker shaft.

1. Measure diameter of shaft at first rocker location.

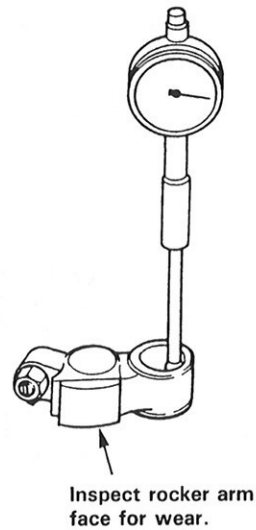


2. Zero gauge to shaft diameter.



3. Measure inside diameter of rocker arm and check for out-of-round condition.

Rocker Arm Radial Clearance:
Service Limit: 0.08 mm (0.003 in.)



Repeat for all rockers. If over limit, replace rocker shaft and all over-tolerance rocker arm.

Valves

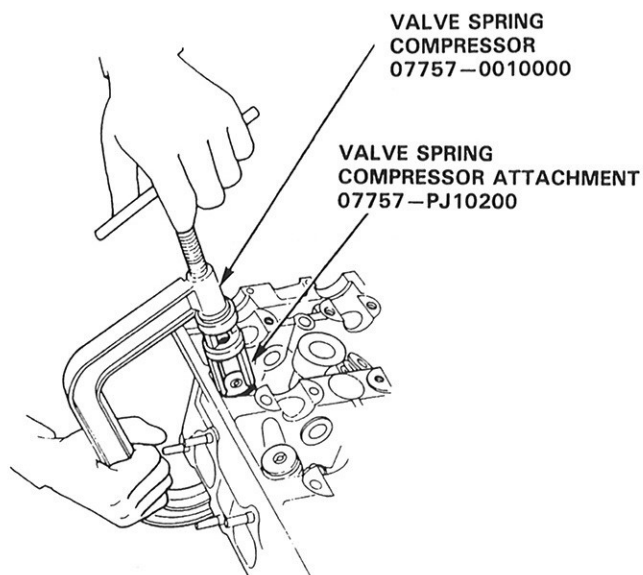
Replacement

NOTE: Identify valves and valve springs as they are removed so that each item can be reinstalled in its original position.

1. Tap each valve stem end perpendicularly with a hammer gripe bottom (refer to page 3-31) to loosen valve keepers before installing spring compressor.

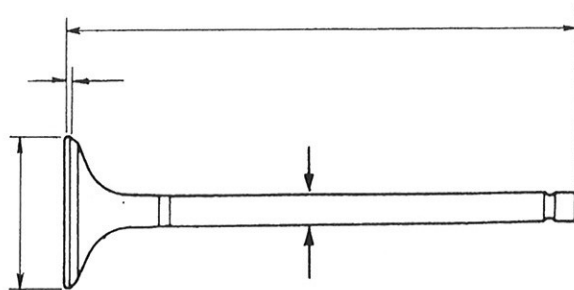
CAUTION: When tapping, care should be taken not to bend the valve stem.

2. Install spring compressor. Compress spring and remove valve keeper.



3. Install the special tool as shown.
4. Remove the valve guide seal.

Valve Dimensions



Intake Valve

- A Standard (New): 32.90–33.10 mm
(1.2953–1.3031 in)
- B Standard (New): 102.20–102.50 mm
(4.0236–4.0354 in)
- C Standard (New): 5.475–5.485 mm
(0.2156–0.2159 in)
- C Service Limit: 5.445 (0.2144 in)
- D Standard (New): 1.05–1.35 mm
(0.0413–0.0531 in)
- D Service Limit: 0.85 mm (0.0335 in)

Exhaust Valve

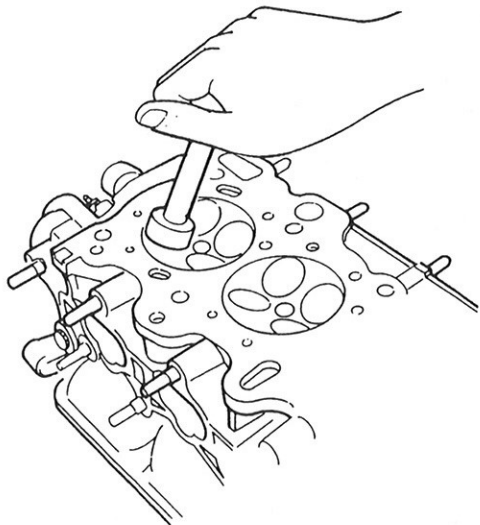
- A Standard (New): 27.90–28.10 mm
(1.0984–1.1063 in)
- B Standard (New): 102.40–102.60 mm
(4.0315–4.0394 in)
- C Standard (New): 5.450–5.460 mm
(0.2146–0.2150 in)
- C Service Limit: 5.420 (0.2134 in)
- D Standard (New): 1.65–1.95 mm
(0.0650–0.0768 in)
- D Service Limit: 1.45 mm (0.0571 in)

Valve Seats

Reconditioning

1. Renew the valve seats in the cylinder head using a valve seat cutters.

NOTE: If guides are worn (page 3-28), replace them (page 3-29) before cutting the valve seats.

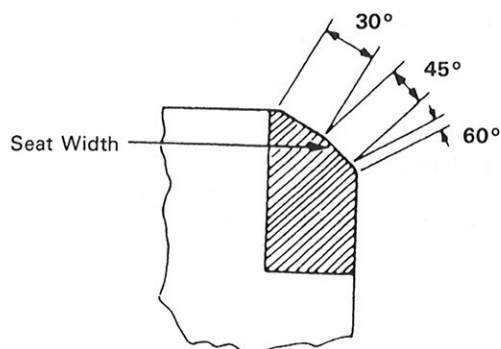


2. Carefully cut a 45° seat, removing only enough material to ensure a smooth and concentric seat.
3. Bevel the upper edge of the seat with the 30° cutter and the lower edge of the seat with the 60° cutter. Check width of seat and adjust accordingly.
4. Make one more very light pass with the 45° cutter to remove any possible burrs caused by the other cutters.

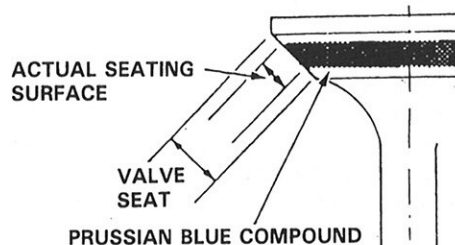
Valve Seat Width:

Standard: 1.25–1.55 mm (0.049–0.061 in.)

Service Limit: 2.0 mm (0.079 in.)



5. After resurfacing the seat, inspect for even valve seating: Apply Prussian Blue Compound to the valve face, and insert valve in original location in the head, then lift it and snap it closed against the seat several times.



6. The actual valve seating surface, as shown by the blue compound, should be centered on the seat.
 - If it is too high (closer to the valve stem), you must make a second cut with the 60° cutter to move it down, then one more cut with the 45° cutter to restore seat width.
 - If it is too low (closer to the valve edge), you must make a second cut with the 30° cutter to move it up, then one more cut with the 45° cutter to restore seat width.

NOTE: The final cut should always be made with the 45° cutter.

7. Insert intake and exhaust valves in the head and measure valve stem installed height.

Intake Valve Stem Installed Height:

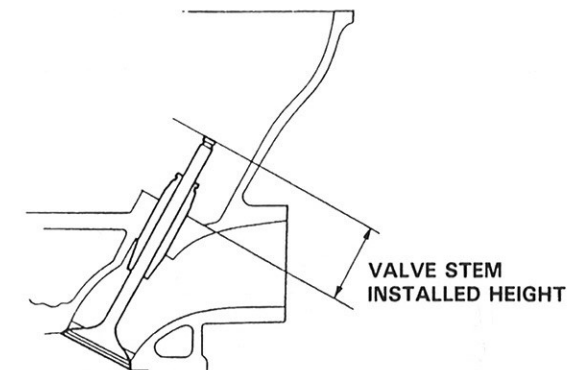
Standard (New): 37.465–37.935 mm
(1.4750–1.4935 in)

Service Limit: 38.185 mm (1.5033 in)

Exhaust Valve Stem Installed Height:

Standard (New): 37.165–37.635 mm
(1.4632–1.4817 in)

Service Limit: 37.885 (1.4915 in)



8. If valve stem installed height is over the service limit, replace valve and recheck. If still over the service limit, replace cylinder head; the valve seat in the head is too deep.

Cylinder head

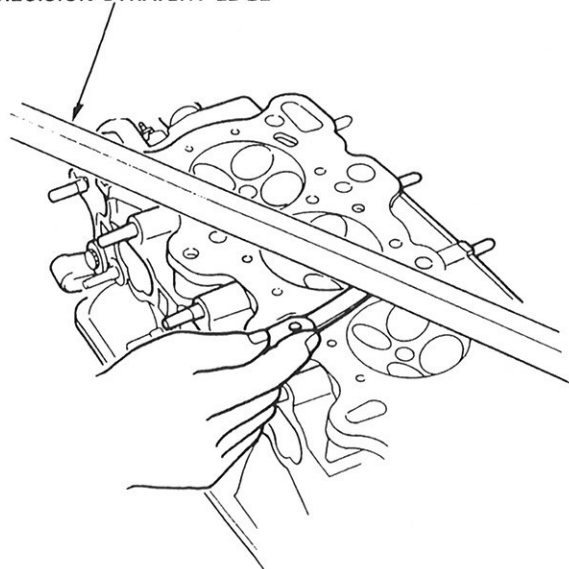
Warpage

NOTE: If camshaft bearing clearances (page 3-17) are not within specification, the head cannot be resurfaced.

If camshaft bearing radial clearance are within specifications, check the head for warpage.

- If warpage is less than 0.05 mm (0.002 in.) cylinder head resurfacing is not required.
- If warpage is between 0.05 mm (0.002 in.) and 0.2 mm (0.008 in.), resurface cylinder head.
- Maximum resurface limit is 0.2 mm (0.008 in.) based on a height of 142 mm (5.59 in.).

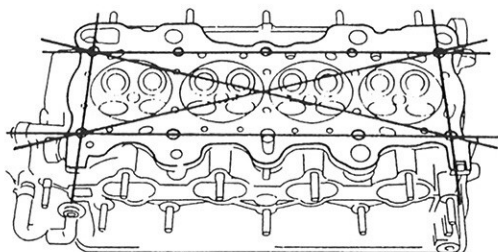
PRECISION STRAIGHT EDGE



Cylinder Head Height:

Standard (New): 141.95–142.05 mm
(5.5886–5.5925 in)

Measure along edges, and 3 ways across center.



Valves

Valve Movement

Measure the guide-to-stem clearance with a dial indicator while rocking the stem in the direction of normal thrust (wobble method).

Intake Valve Stem-to-Guide Clearance:

Standard (New): 0.07–0.09 mm
(0.0028–0.0035 in)

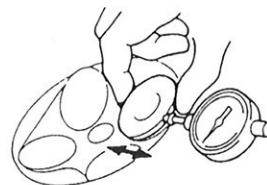
Service Limit: 0.15 mm (0.0059 in)

Exhaust Valve Stem-to-Guide Clearance:

Standard (New): 0.10–0.16 mm
(0.0039–0.0063 in)

Service Limit: 0.24 mm (0.0094 in)

Valve extended 10 mm out from seat.



- If measurement exceeds the service limit, recheck using a new valve.
- If measurement is now within the service limit, reassemble using a new valve.
- If measurement still exceeds limit, recheck using alternate method below, then replace valve and guide, if necessary.

NOTE: An alternate method of checking guide to stem clearance is to subtract the O.D. of the valve stem, measured with a micrometer, from the I.D. of the valve guide, measured with an inside micrometer or ball gauge.

Take the measurements in three places along the valve stem and three places inside the valve guide. The difference between the largest guide measurement and the smallest stem measurement should not exceed the service limit.

Intake Valve Stem-to-Guide Clearance:

Standard (New): 0.035–0.045 mm
(0.0014–0.0018 in)

Service Limit: 0.075 mm (0.0030 in)

Exhaust Valve Stem-to-Guide Clearance:

Standard (New): 0.050–0.080 mm
(0.0020–0.0031 in)

Service Limit: 0.120 mm (0.0047 in)

Valve Guides

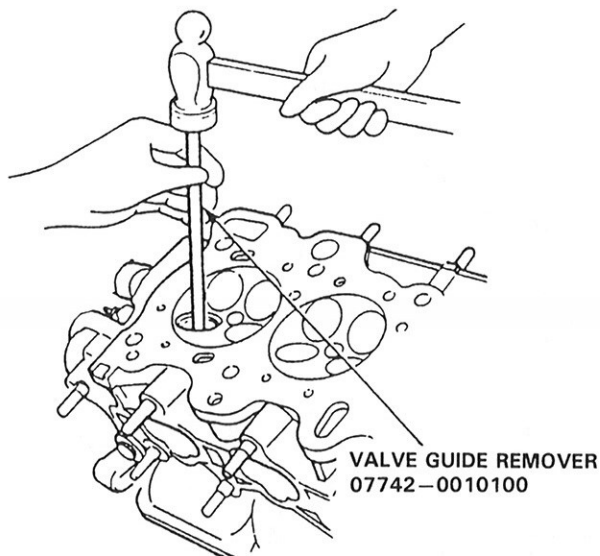
Replacement

NOTE:

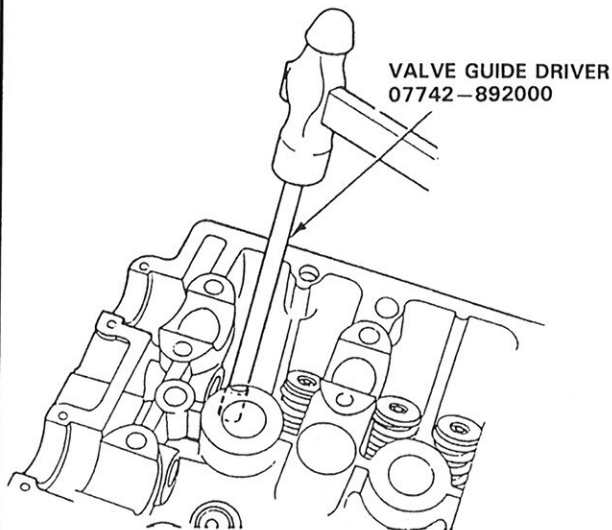
- For best results, heat cylinder head to 150°C (300°F) before removing or installing guides.
- It may be necessary to use an air hammer to remove some valve guides.

CAUTION: To avoid burns, use heavy gloves when handling heated cylinder head.

1. Drive the valve guide out from the bottom of the cylinder head.



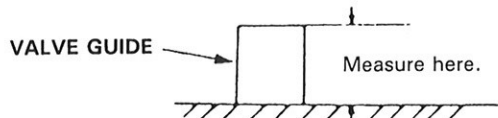
2. Drive in a new valve guide to the specified depth.



Valve Guide Installed Height:

Intake: 12.55–13.05 mm (0.4941–0.5138 in)

Exhaust: 12.55–13.05 mm (0.4941–0.5138 in)



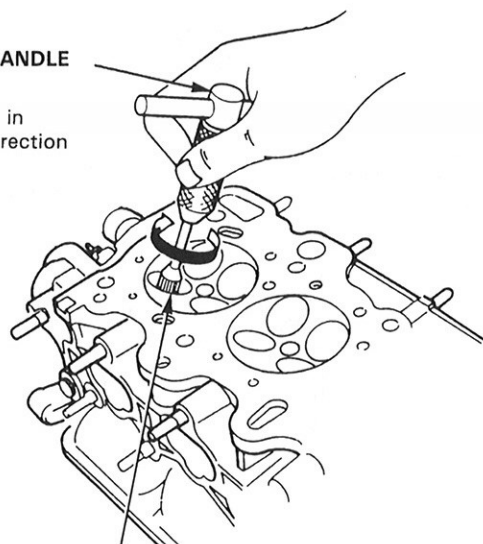
Valve Guide Reaming

NOTE: For new valve guides only.

1. Coat both reamer and valve guide with cutting oil.
2. Rotate the reamer clockwise the full length of the valve guide bore.
3. Continue to rotate the reamer clockwise while removing it from the bore.
4. Thoroughly wash the guide in detergent and water to remove any cutting residue.
5. Check clearance with a valve (page 3-28).
 - Verify that the valve slides in the IN, EX valve guides without exerting pressure.

REAMER HANDLE

Turn reamer in clockwise direction only.

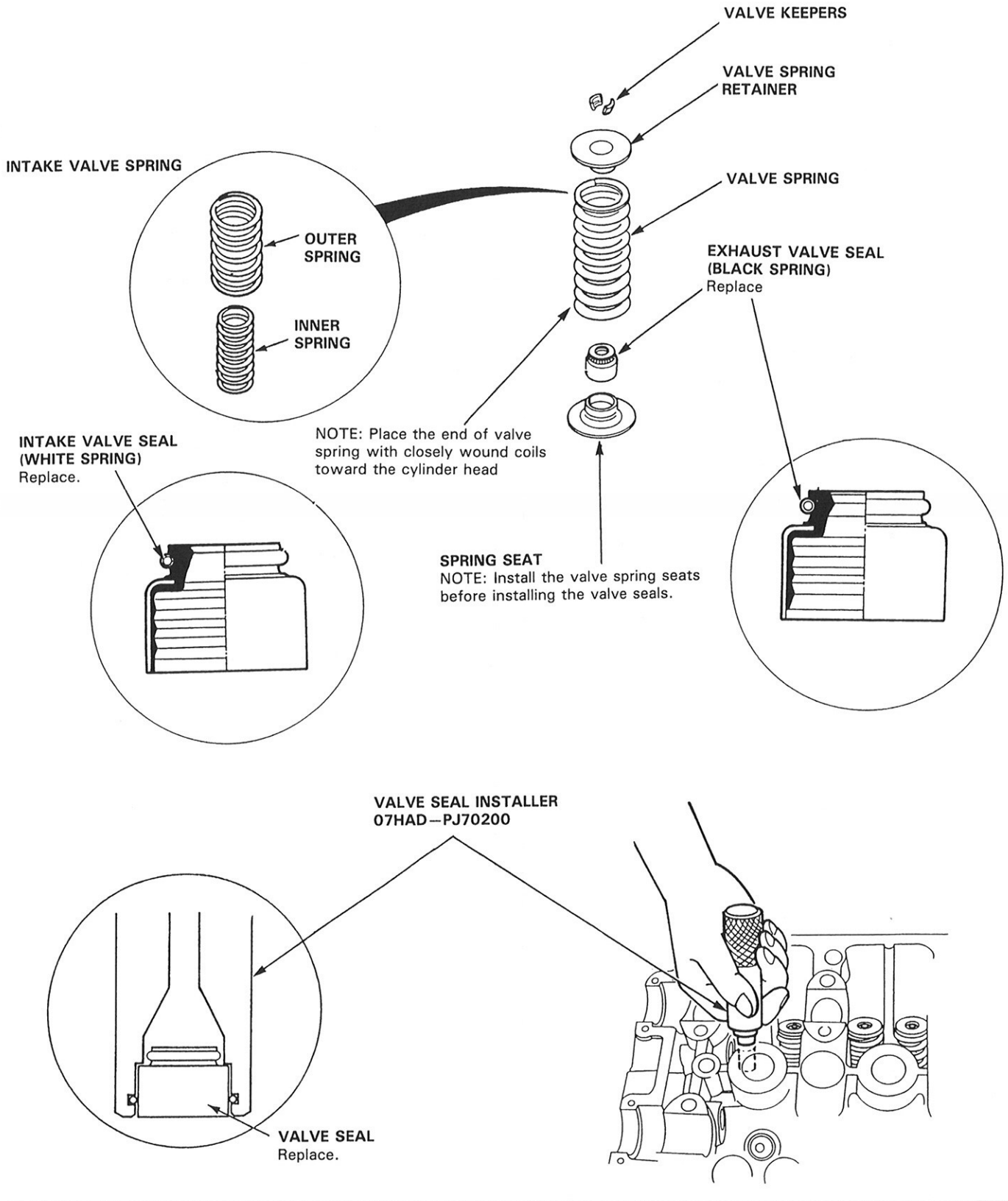


VALVE GUIDE REAMER, 5.5 mm
07HAH-PJ70100

Valve Springs and Valve Seals

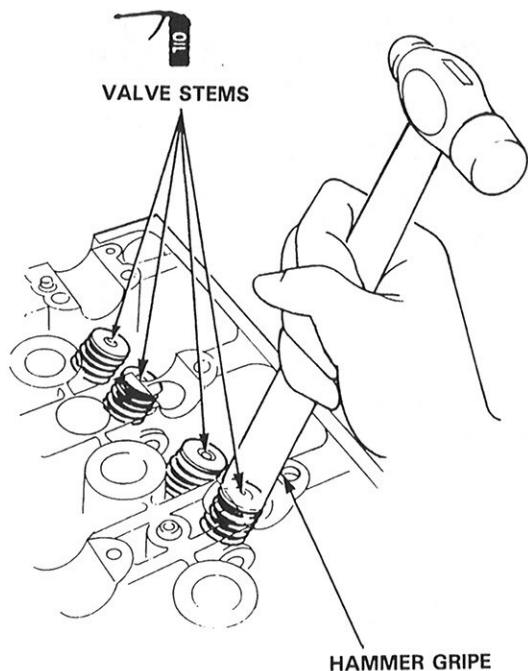
Valve Spring and Valve Seal Installation Sequence

NOTE: Exhaust and intake valve seals are NOT interchangeable.



Valve Installation

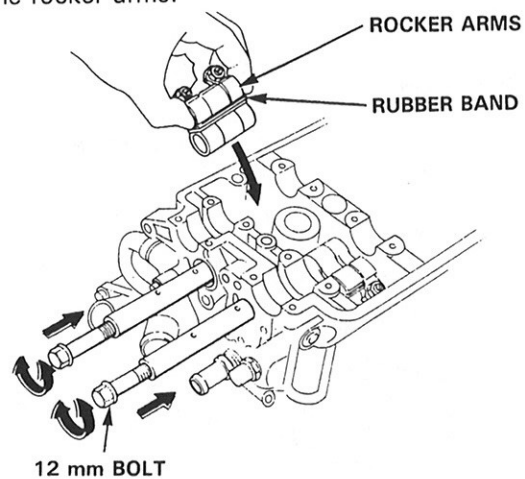
- When installing valves in cylinder head, coat valve stems with oil before inseting into valve guides, and make sure valves move up and down smoothly.
- When valves and springs are in place, lightly tap the end of each valve stem two or three times to ensure proper seating of valve and valve keepers (use hammer gripe bottom).



Roker Arms

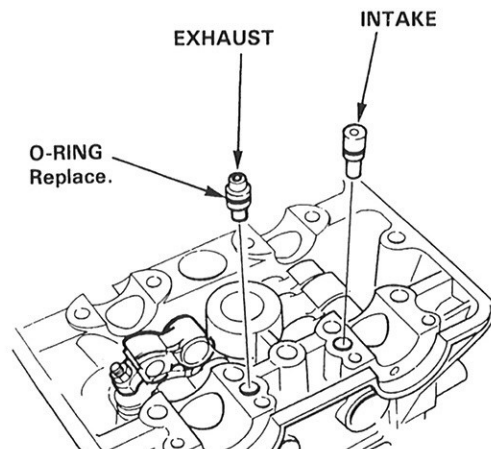
Installation

1. Install the rocker arms in the reverse order of removal:
 - Valve adjusting locknuts should be loosened and adjusting screw backed off before installation.
 - The compnrnent parts must be reinstalled in the original locations.
2. Install the lost mortion assembly.
3. Install the rocker arms while passing the rocker arm shaft through the cylinder head.



4. Install the orifices. If the holes in the rocker arm shaft and cylinder head are not in line each other, mount a 12 mm bolt on the rocker arm shaft and rotate the shaft.

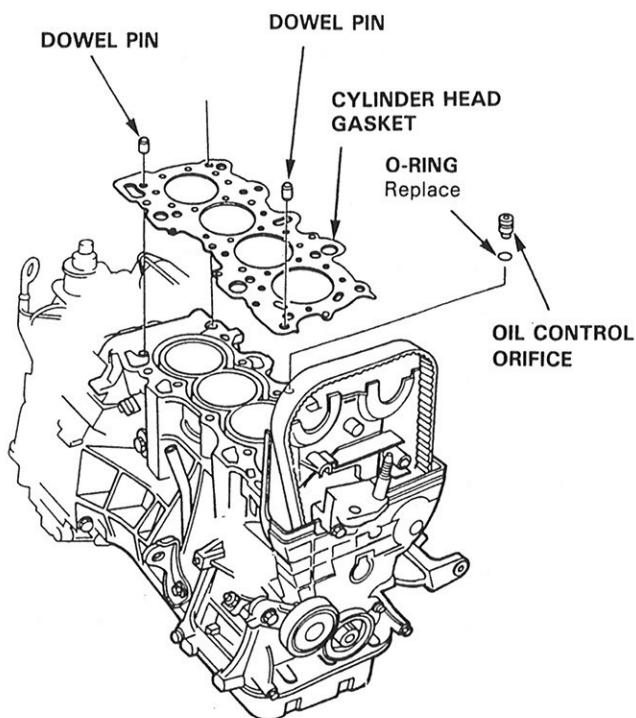
NOTE: The shapes of the orifices for the intake and exhaust are different. The orifices must be installed in the original locations.



Cylinder Head

Installation

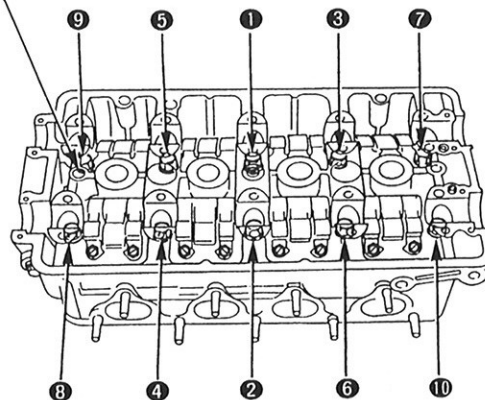
1. Install the cylinder head in the reverse order of removal:
 - Always use a new head and manifold gasket.
 - The cylinder head gasket is a metal gasket. Take care not to bend it.
 - Rotate the crankshaft, set the No. 1 piston at TDC (page 2-7).
2. Install the the cylinder head gasket, dowel pins and the head oil control orifice on the cylinder head.



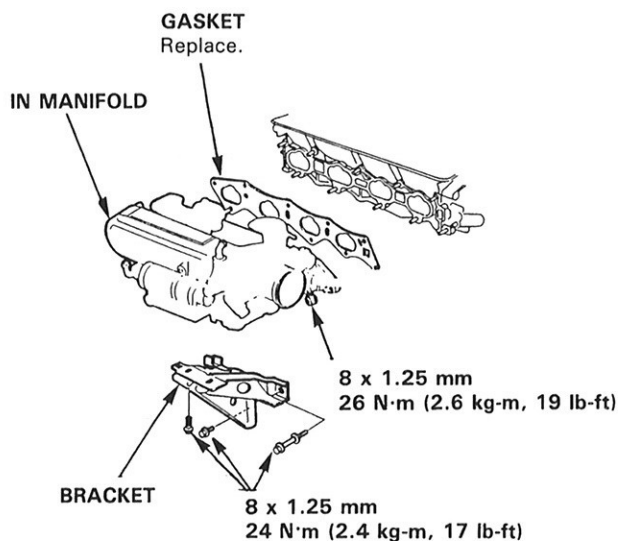
3. Tighten cylinder head bolts in two steps. In the first step, tighten all bolts in sequence, to about 30 N·m (3.0 kg-m, 22 lb-ft). In the final step, tighten in same sequence to 85 N·m (8.5 kg-m, 61 lb-ft).
NOTE: Apply clean engine oil to the bolt threads and under the bolt head.

CYLINDER HEAD BOLT TORQUE SEQUENCE

11 x 1.5 mm
85 N·m (8.5 kg-m, 61 lb-ft)



4. Install the intake manifold and tighten the nuts in a criss-cross pattern in two or three steps, beginning with the inner nuts.



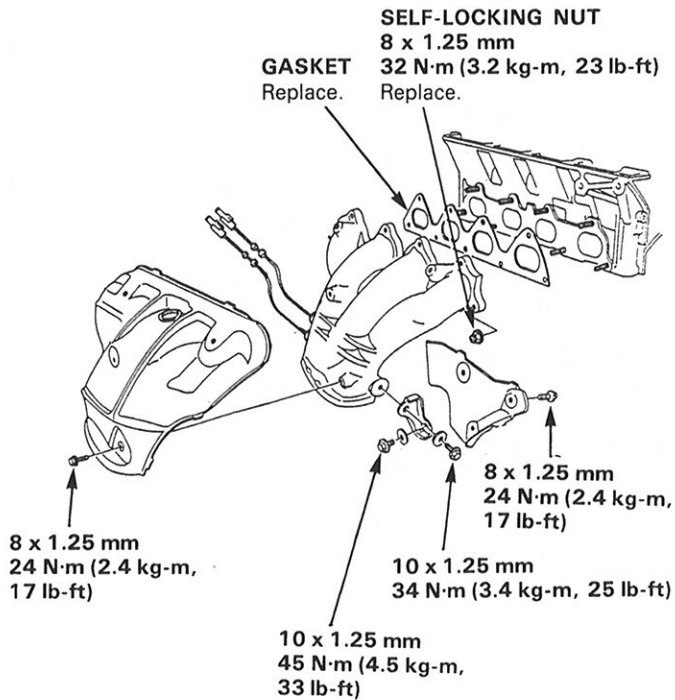
Camshafts

Installation

5. Install the exhaust manifold and tighten the new self-locking nuts in a criss-cross pattern in two or three steps, beginning with the inner nuts.

CAUTION:

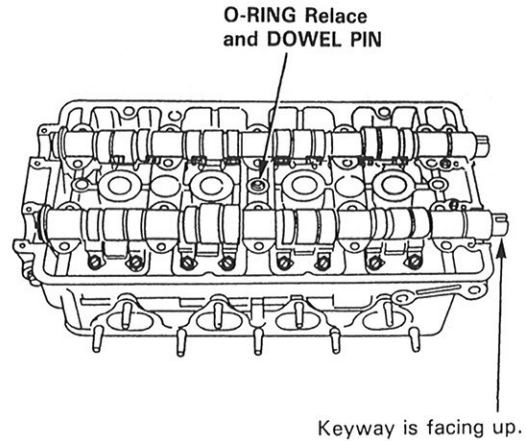
- Install the oxygen sensors after installing the exhaust manifold.
- Do not use air wrench for tightening the self-locking nuts, if oxygen sensors are not to be removed.



1. Install the camshafts and camshaft oil seals.

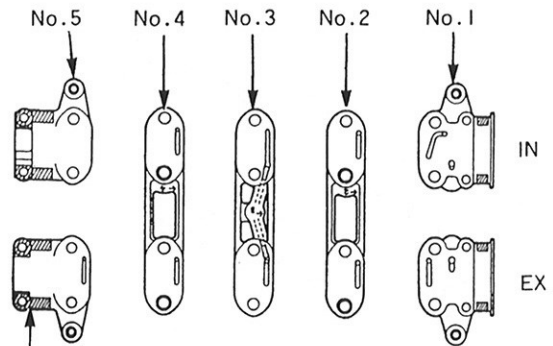
NOTE:

- Install the camshafts with keyway facing up.
- Install the oil seal with the spring side face in.
- The oil seal housing surface should be dry.
- Set the O-ring and dowel pin in the oil passage of the No. 3 camshaft holder.



2. Apply liquid gasket to the head mating surface of the No. 1 and No. 5 camshaft holders on both the intake and exhaust side. Confirm that the camshaft keyway are face up, then place the holders, togher with the No. 2, No. 3 and No. 4 camshaft holders, on the cylinder head.

CAMSHAFT HOLDERS



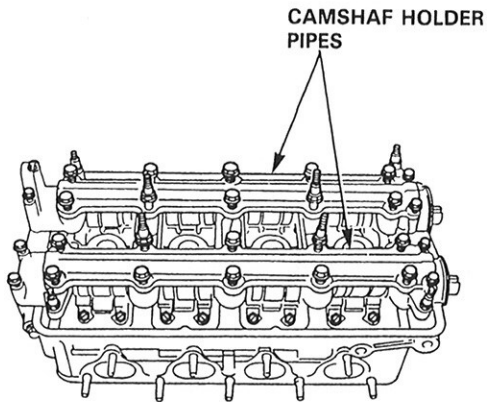
Apply liquid gasket to the shaded areas.

(cont'd)

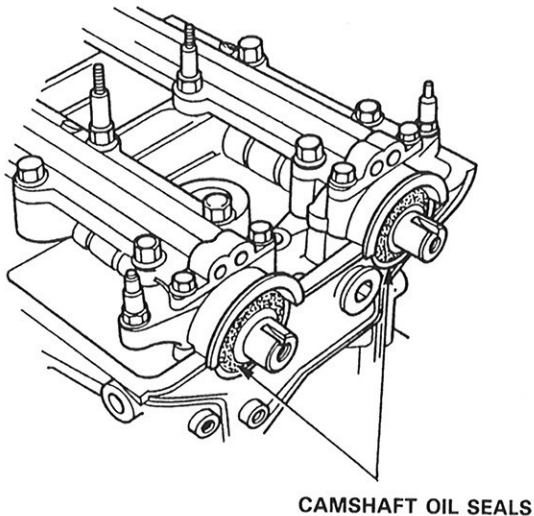
Camshafts

Installation (cont'd)

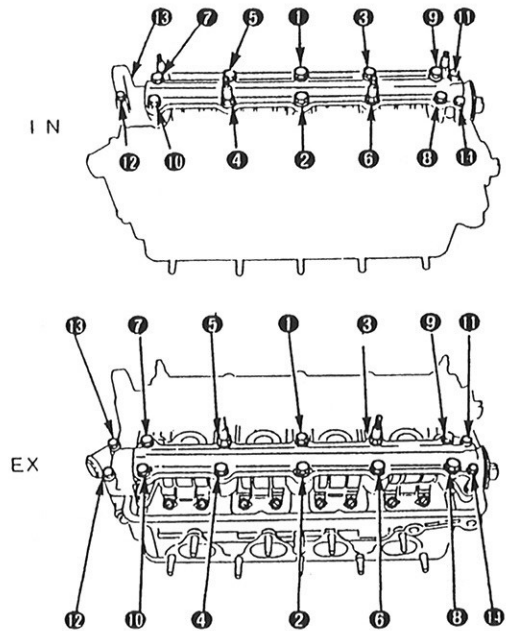
- Temporarily tighten the bolts of the camshaft holders and the camshaft holder pipes.



- Push the camshaft oil seal securely against the base of the camshaft holder.



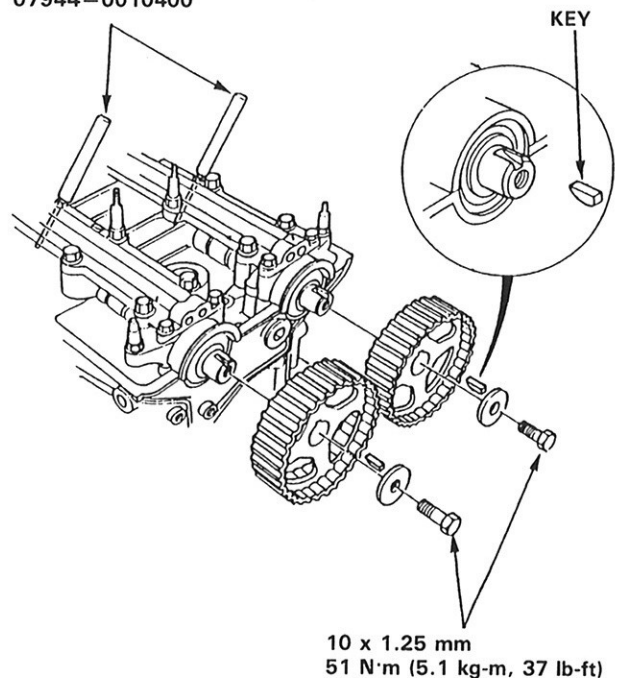
- Tighten the bolts in the sequence shown below.



- ① - ⑩ : 8 x 1.25 mm 22 N·m (2.2 kg-m, 16 lb-ft)
- ⑪ - ⑫ : 6 x 1.0 mm 11 N·m (1.1 kg-m, 8 lb-ft)

- Install the back cover of the timing belt.
- Install the camshaft pulleys.
NOTE: Align the hole in the camshaft holder with the hole in the camshaft as shown below, then insert the pin driver 5.0 mm and set the camshaft at TDC.

PIN DRIVER 5.0 mm
07944-0010400



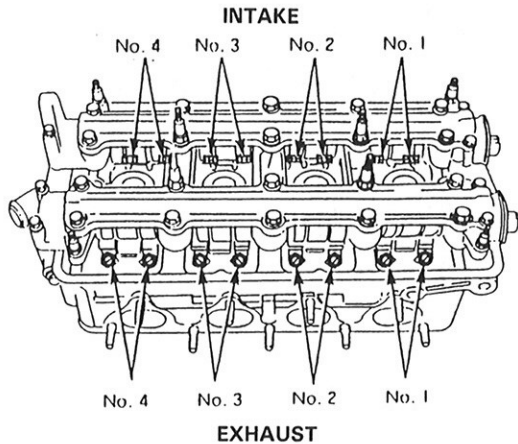
Valve Clearance

Adjustment

NOTE:

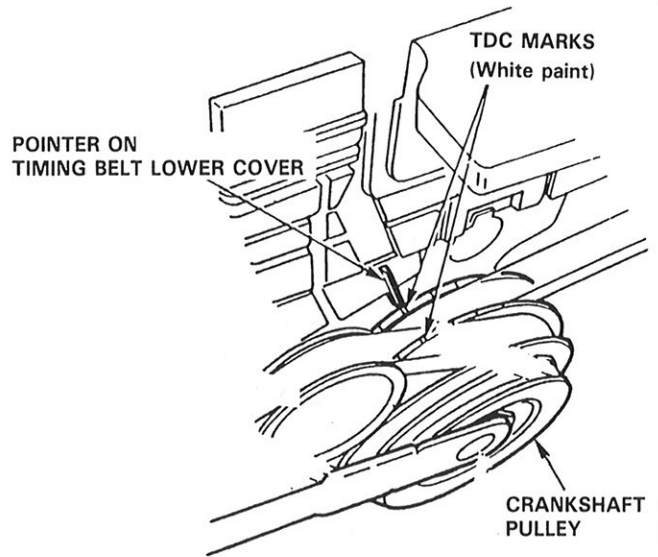
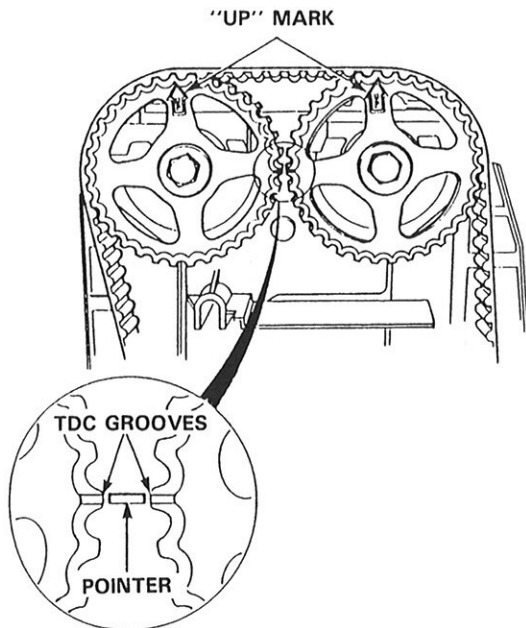
- Valves should be adjusted when the cylinder head temperature is less than 38°C (100°F). Adjustment is the same for both intake and exhaust valves.
- If the pulley bolt loosens while turning the crank, retorque it to 120 N·m (12.0 kg-m, 87 lb-ft).

- Remove valve cover.

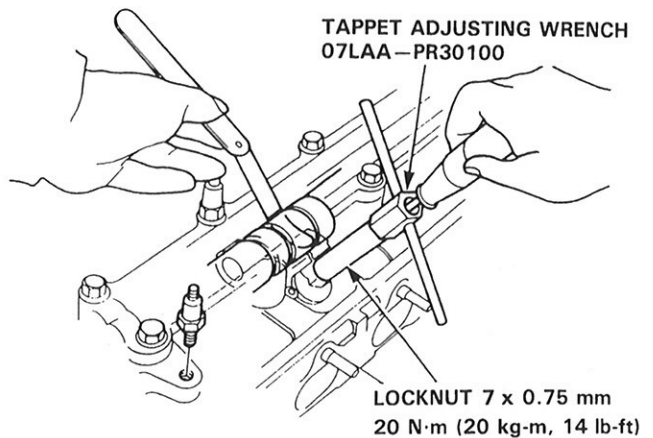


- Set the No. 1 piston at TDC. "UP" mark on the pulley should be at the top, and the TDC grooves on the pulley should align with the pointer on timing belt back cover. TDC grooves (white paint) on the crankshaft pulley should align with pointer on the timing belt lower cover.

Number 1 Piston at TDC



- Adjust valve clearance on No. 1 cylinder.
Intake: 0.15–0.19 mm (0.006–0.007 in.)
Exhaust: 0.17–0.21 mm (0.007–0.008 in.)
- Loosen the locknut and turn the adjustment screw until feeler gauge sides back and forth with a slight amount of drag.

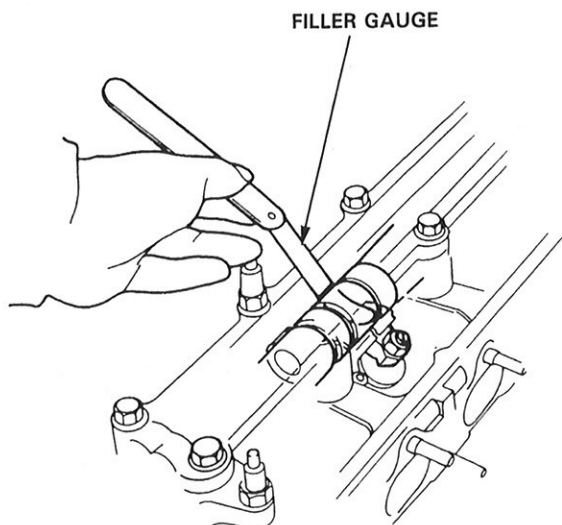


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Valve Clearance

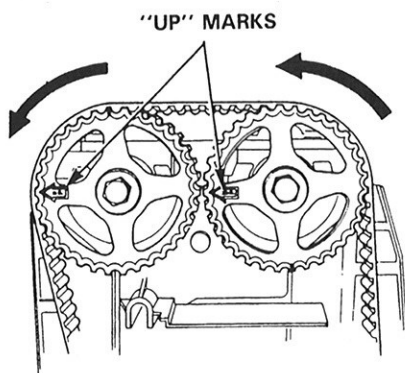
Adjustment (cont'd)

5. Tighten the locknut and recheck clearance again. Repeat adjustment if necessary.



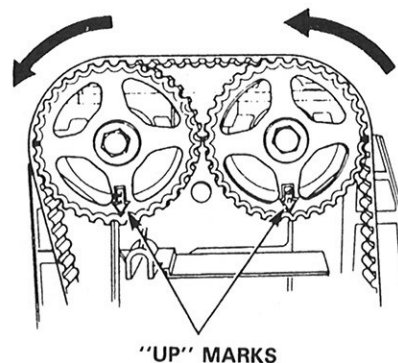
6. Rotate the crankshaft 180° counterclockwise (cam pulley turns 90°). The "UP" mark should be on the exhaust side. Adjust valves on No.3 cylinder.

Number 3 piston at TDC



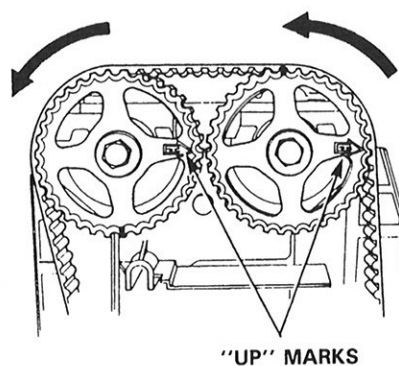
7. Rotate the crankshaft 180° counterclockwise to bring No. 4 piston to TDC. Both TDC grooves are once again visible. Adjust on No. 4 cylinder.

Number 4 piston at TDC



8. Rotate the crankshaft 180° counterclockwise to bring No. 2 piston to TDC. The "UP" marks should be on the intake side. Adjust valves on No. 2 cylinder.

Number 2 piston at TDC.



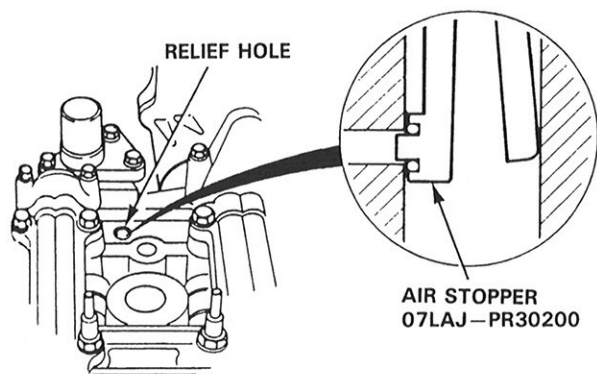
Rocker Arms

Inspection Using Special Tools

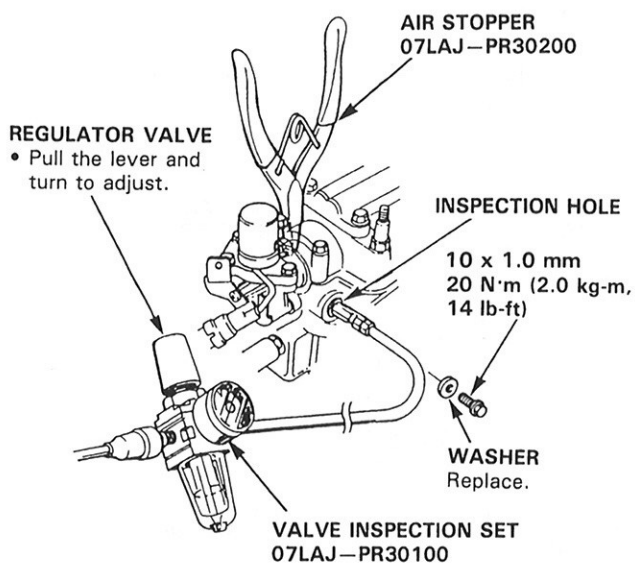
CAUTION:

- Before using the special tool (Valve Inspection Set), make sure that the air pressure gauge on the air compressor indicates over 245 kPa (2.5 kg/cm², 36 psi).
- Inspect the valve clearance before rocker arm inspection.
- Cover the timing belt with shop towel to prevent the belt.
- Check the mid rocker arm of each cylinder at TDC.

1. Remove the valve cover.
2. Plug the relief hole with the special tool (Air Stopper).



3. Remove the bolt and washer from the inspection hole and connect the special tool (Valve Inspection Set).



(cont'd)

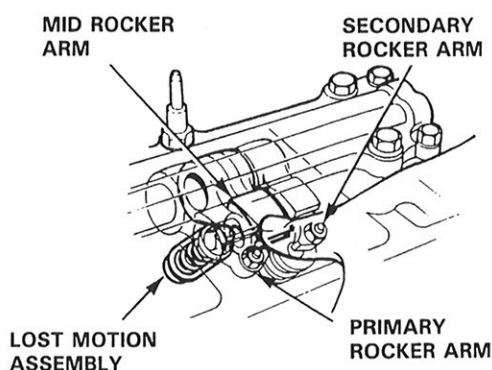
Rocer Arms

Inspection Using Special Tools (cont'd)

- Apply specified air pressure to the rocker arm pistons after loosening the regulator valve on the valve inspection set.

Specified Air Pressure:
245 kPa (2.5 kg/cm², 36 psi)
 — **490 kPa (5.0 kg/cm², 71 psi)**

- Make sure that the primary and secondary rocker arms are mechanically connected by pistons and that the mid rocker arms do not move when pushed manually.



- If the mid rocker arms independently of the primary and secondary rocker arms, replace the rocker arms, as a set.
- Remove the special tools.
 - Check for smooth operation of the lost motion assembly. It is compressed slightly when the mid rocker arm is lightly pushed and compressed deeply when the mid rocker arm is strongly pushed.
 - Replace the lost motion assembly if it does not move smoothly.
 - After inspection, check that the ECU does not come on.

Drive Belts

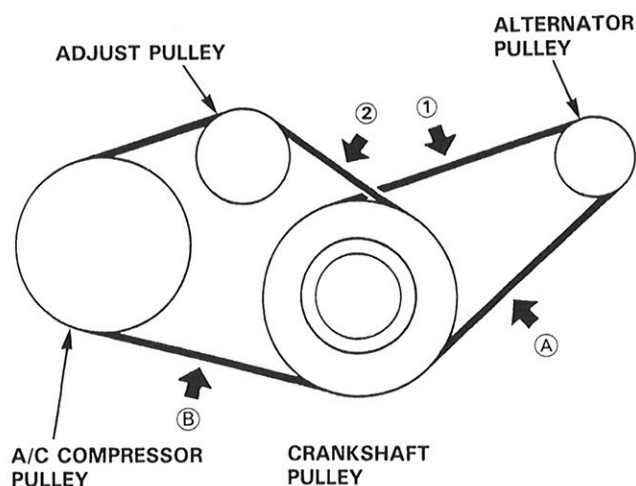
Inspection

Drive Belts Deflection:
(When applying a force of 98 N (10 kg, 22 lb))

	Used Belt	New Belt
① Alternator Belt	8.5–10.5 mm (0.33–0.41 in.)	5.5–7.5 mm (0.22–0.30 in.)
② A/C Compressor Belt	9.0–11.0 mm (0.35–0.43 in.)	7.0–9.0 mm (0.28–0.35 in.)

Measure with the belt tension gauge:

	Use Belt	New Belt
Ⓐ Alternator Belt	343–490 N (35–50 kg) (77–110 lb)	588–785 N (60–80 kg) (132–176 lb)
Ⓑ A/C Compressor Belt	343–490 N (35–50 kg) (77–110 lb)	539–735 N (55–75 kg) (121–165 lb)



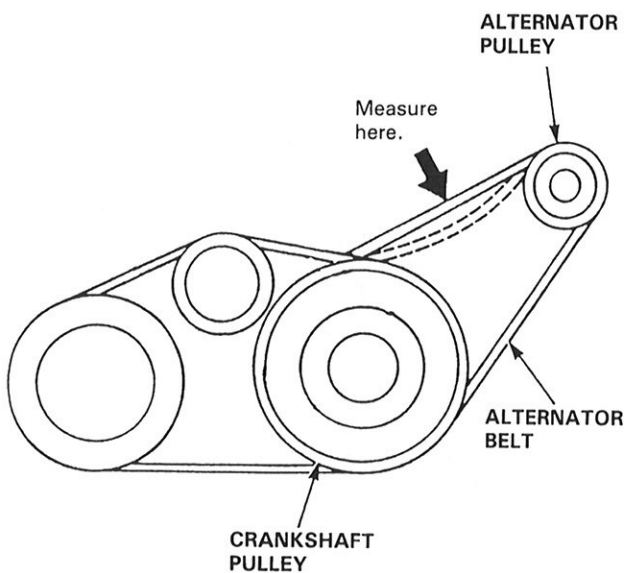
Alternator Belt Adjustment

1. Apply a force of 98 N (10 kg, 22 lb) and measure the deflection between the alternator and the crankshaft pulley.

Deflection: 85–10.5 mm (0.33–0.41 in.)

NOTE:

- On a brand-new belt, the deflection should be 5.5–7.5 mm (0.22–0.30 in.) when first measured.
- If there are cracks or any damage evident on the belt, replace it with a new one.



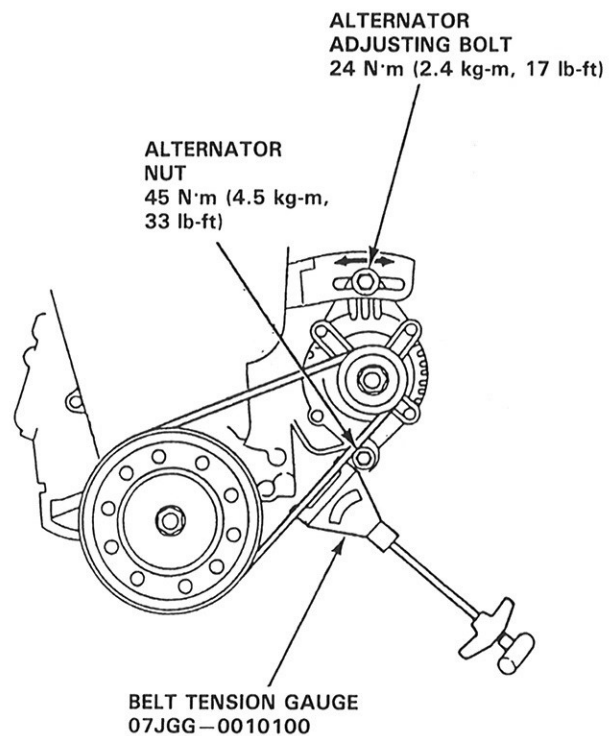
Measure with the belt tension gauge:

Attach the belt tension gauge to the belt and measure the tension of the belt.

Tension: 343–490 N (35–50 kg, 77–110 lb)

NOTE:

- On a brand-new belt, the tension should be 588–785 N (60–80 kg, 132–176 lb) when first measured.
- See the instruction for the belt tension gauge.
- If there are cracks or any damage evident on the belt, replace it with a new one.



2. Loosen the alternator adjusting bolt and alternator nut.
3. Move the alternator to obtain the proper belt tension, then retighten the adjusting bolt and alternator nut.
4. Recheck the deflection of the belt.
5. After adjusting, if necessary adjust the A/C compressor belt (See page 3-40).

Drive Belts

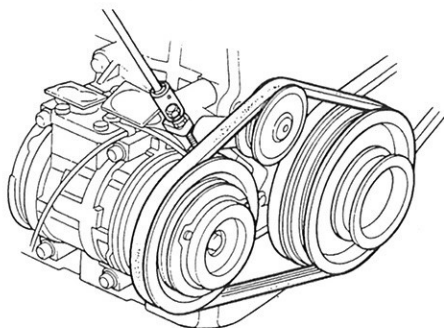
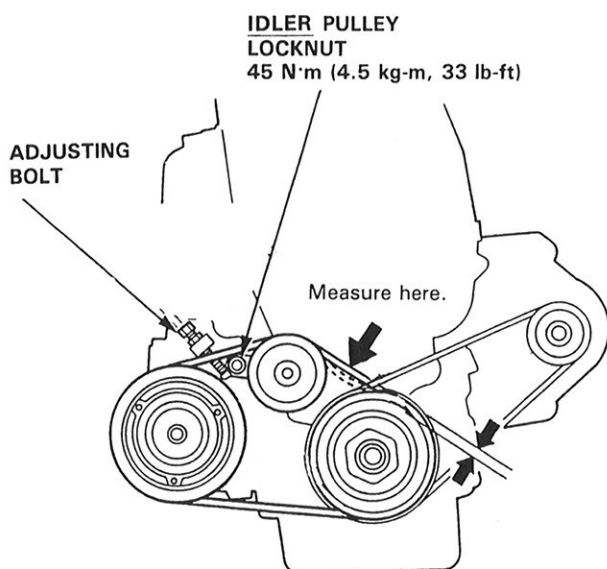
A/C Compressor Belt Adjustment

NOTE: If there are cracks or any damage evident on the belt, replace it with a new one.

1. Apply a force of 98 N (10 kg, 22 lb) and measure the deflection, between the A/C compressor idler pulley and the crankshaft pulley.

Deflection: 7.0–9.0 mm (0.28–0.35 in.)

NOTE: On a brand-new belt, the deflection should be 4.5–6.5 mm (0.18–0.26 in.) when first measured.



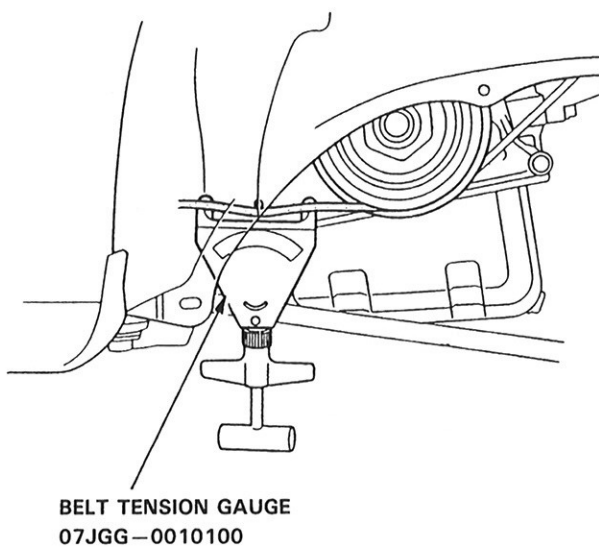
Measure with the belt tension gauge:

Attach the belt tension gauge to the belt and measure the tension of the belt.

Tension: 343–490 IN (35–50 kg, 77–110 lb)

NOTE:

- On a brand-new belt, the tension should be 539–735 N (55–75 kg, 121–165 lb) when first measured.
- See the instruction for the belt tension gauge.



2. Loosen the idler pulley locknut.
3. Turn the adjusting bolt to get the proper belt tension, then retighten the bolt.
4. Recheck the deflection of the belt.

Engine Block

Standards and Service Limits	4-2
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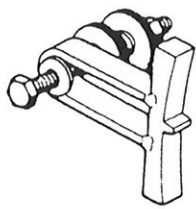
Standard and Service Limits

Umit: mm (in)

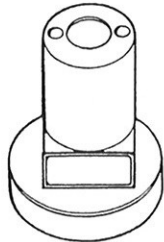
	MEASUREMENT	STANDARD (NEW)	SERVICE LIMIT
Cylinder block	Warpage of deck surface	0.05 (0.0020)	0.10 (0.004)
	Bore diameter	X 81.000—81.020 (3.1890—3.1898)	} 81.070 (3.1917)
		Y 81.000—81.015 (3.1890—3.1896)	
	Bore taper	—	0.05 (0.002)
Reboring limit	—	0.25 (0.01)	
Piston	Skirt O. D. At 15 mm (0.59 in) from bottom of skirt	80.98—80.99 (3.1882—3.1886)	80.97 (3.1879)
	Clearance in cylinder	0.01—0.04 (0.0004—0.0016)	0.05 (0.002)
	Ring groove width	Top 1.030—1.040 (0.0406—0.0409)	1.060 (0.0417)
		2nd 1.230—1.240 (0.0484—0.0488)	1.260 (0.0496)
	Oil	2.805—2.820 (0.1104—0.1110)	2.840 (0.118)
Piston ring	Piston-to-ring clearance	Top 0.045—0.070 (0.0018—0.0028)	0.130 (0.0051)
		2nd 0.045—0.070 (0.0018—0.0028)* 1	} 0.130 (0.0051)
	Ring end gap	0.040—0.065 (0.0015—0.0026)* 2	
		Top 0.20—0.35 (0.0079—0.0138)	0.60 (0.0236)
		2nd 0.40—0.55 (0.0157—0.0217)	0.70 (0.0276)
	* 1 TEIKOKU PISTON RING made * 2 RIKEN made	Oil 0.20—0.45 (0.0079—0.0177)* 1	} 0.80 (0.0315)
		0.20—0.50 (0.0079—0.0197)* 2	
Piston pin	Diameter	20.994—21.000 (0.8265—0.8268)	—
	Pin-to-piston clearance	0.010—0.022 (0.0004—0.0009)	—
Connecting rod	Pin-to-rod interference	0.013—0.032 (0.0005—0.0013)	—
	Small end bore diameter	20.968—20.981 (0.8255—0.8260)	—
	Large end bore diameter	Nominal 48.0 (1.89)	—
	End play installed on crankshaft	0.15—0.30 (0.0059—0.0118)	0.40 (0.0157)
Crankshaft	Main journal diameter		
	No. 1, 2, 4 and 5 journals	54.976—55.000 (21.644—2.1654)	—
	No. 3 journal	54.970—54.994 (2.1642—2.1651)	—
	Rod journal diameter	44.976—45.000 (1.7707—1.7717)	—
	Journal taper	0.005 (0.00020) max.	—
	Journal out of round	0.004 (0.00016) max.	0.006 (0.00023)
	End play	0.10—0.35 (0.0039—0.0138)	0.045 (0.0018)
Ranout	0.02 (0.0008) max.	0.03 (0.0012)	
Bearing	Main bearing-to-journal oil clearance		
	No. 1, 2, 4 and 5 journals	0.024—0.042 (0.0009—0.0017)	0.050 (0.0020)
	No. 3 journal	0.030—0.048 (0.0012—0.0019)	0.060 (0.0024)
	Rod bearing-to-journal oil clearance	0.032—0.050 (0.0013—0.0020)	0.060 (0.0024)

Special Tools

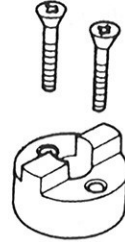
Ref. No.	Tool Number	Description	Q'ty	Remarks
①	07924-PD20003	Ring Gear Holder	1	
②	07973-6570500	Piston Base	1	
③	07HAF-PL20102	Piston Base Head	1	
④	07973-6570600	Piston Base Spring	1	
⑤	07973-PE00310	Piston Pin Driver Shaft	1	
⑥	07973-PE00320	Piston Pin Driver Head	1	
⑦	07LAF-PR30100	Pilot Coller	1	
⑧	07GAF-PH60300	Piston Pin Base Insert	1	
⑨	07948-SB00101	Oil Seal Driver Attachment	1	Crankshaft oil seal (clutch side)
⑩	07749-0010000	Driver	1	



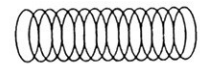
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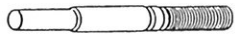
②



③



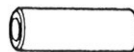
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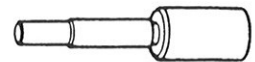
⑤



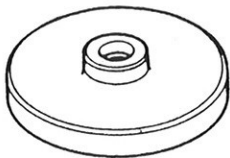
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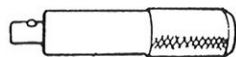
⑦



⑧



⑨

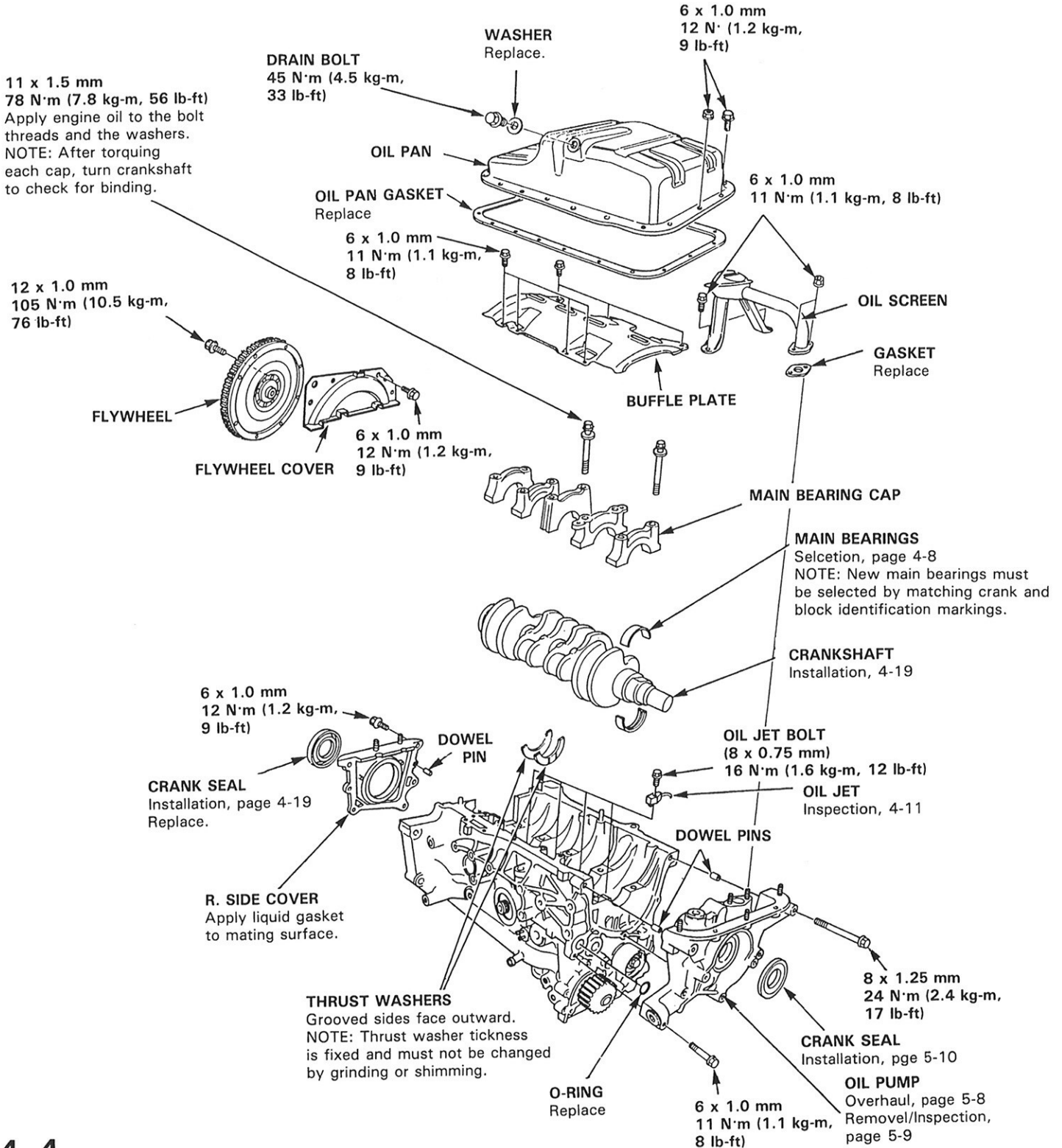


⑩

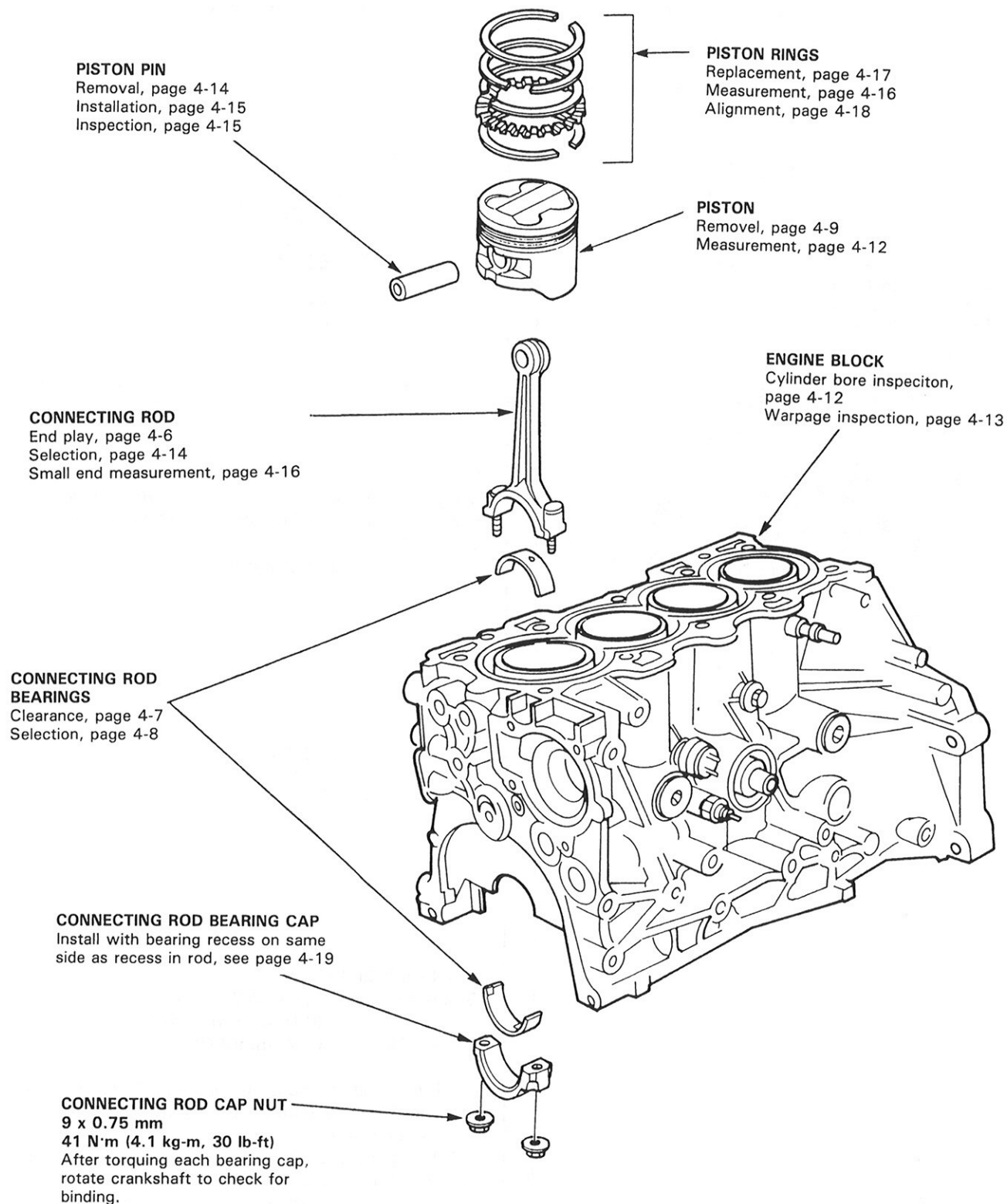
Engine Block

Illustrated Index

NOTE: Lubricate all internal parts with engine oil during reassembly.



NOTE: New rod bearings must be selected by matching connecting rod and crankshaft identification markings (page 4-8).



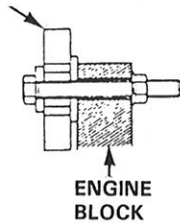
Flywheel

Replacement

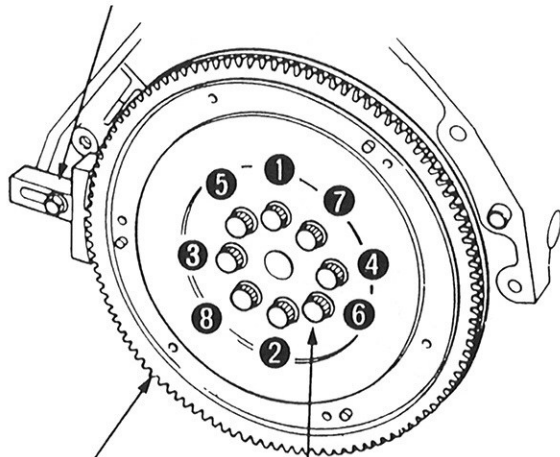
Manual Transmission:

Remove the eight flywheel bolts, then separate the flywheel from the crankshaft flange. After installation, tighten the bolts in the sequence shown.

RING GEAR HOLDER
07924-PD20003 or 07924-PD20002



RING GEAR HOLDER
07924-PD20003 or
07924-PD20002



RING GEAR
Inspect ring gear
teeth for wear or
damage.

12 x 1.0 mm
105 N·m
(10.5 kg-m, 76 lb-ft)

Connecting Rod and Crankshaft

End Play

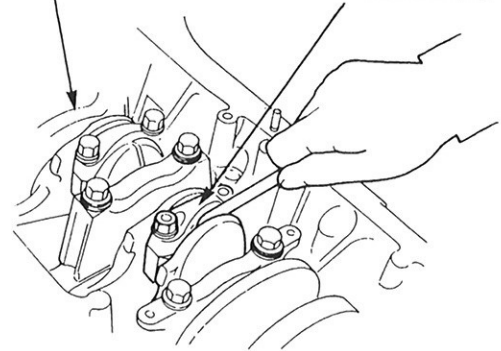
Connecting Rod End Play:

Standard (New): 0.15–0.30 mm
(0.006–0.012 in.)

Service Limit: 0.40 mm (0.016 in.)

CRANKSHAFT

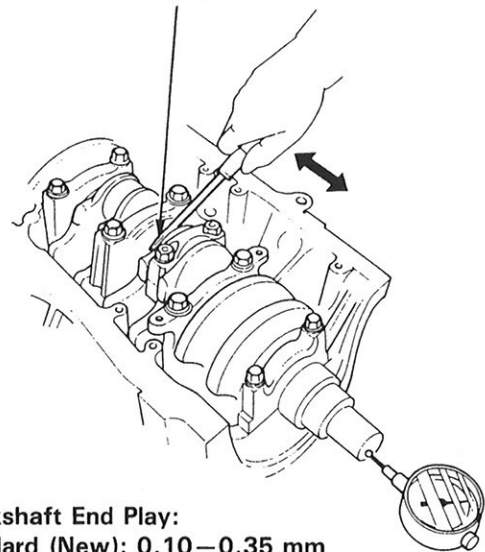
CONNECTING ROD



- If out-of-tolerance, install new connecting rod.
- If still out-of-tolerance, replace crankshaft (pages 4-9 and 4-19).

Push crank firmly away from dial indicator, and zero dial against end of crank. Then pull crank firmly back toward indicator; dial reading should not exceed service limit.

SCREWDRIVER



Crankshaft End Play:

Standard (New): 0.10–0.35 mm
(0.004–0.014 in.)

Service Limit: 0.45 mm (0.018 in.)

- If end play is excessive, inspect thrust washers and thrust surface on crankshaft. Replace parts as necessary.

NOTE: Thrust washer thickness is fixed and must not be changed either by grinding or shimming. Thrust washers are installed with grooved sides outward.

Main Bearings

Clearance

1. To check main bearing clearance, remove the main caps and bearing halves.
2. Clean each main journal and bearing half with a clean shop rag.
3. Place one strip of plastigage across each main journal.
NOTE: If the engine is still in the car when you bolt the main cap down to check clearance, the weight of the crank and flywheel will flatten the plastigage further than just the torque on the cap bolts, and give you an incorrect reading. For an accurate reading, support the crank with a jack under the counterweights and check only one bearing at a time.
4. Reinstall the bearings and caps, then torque the bolts.
12 x 1.5 mm
78 N·m (7.8 kg-m, 56 lb-ft)
5. Remove the caps and bearings again, and measure the widest part of the plastigage.

Main Bearing Clearance:

Standard (New)

No. 1, 2, 4 and 5 journals:

0.024–0.042 mm (0.0010–0.0017 in.)

No. 3 journal:

0.030–0.048 mm (0.0012–0.0019 in.)

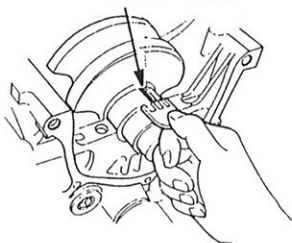
Service Limit:

No. 1, 2, 4 and 5 journals:

0.050 mm (0.0020 in.)

No. 3 journal: 0.060 mm (0.0024 in.)

PLASTIGAGE STRIP



6. If the plastigage measures too wide or too narrow, loosen the main caps and spin the top half of the bearing out of the block, then install a new, complete bearing with the same color code (select the color as shown on the next page), and recheck the clearance.

CAUTION: Do not file, shim, or scrape the bearings or the caps to adjust clearance.

7. If the plastigage shows the clearance is still incorrect, try the next larger or smaller bearing (the color listed above or below that one), and check again.

NOTE: If the proper clearance cannot be obtained by using the appropriate larger or smaller bearings, replace the crank and start over.

Rod Bearings

Clearance

1. Remove the connecting rod cap and bearing half.
2. Clean the crankshaft rod journal and bearing half with a clean shop rag.
3. Place plastigage across the rod journal.
4. Reinstall the bearing half and cap, and torque the nuts.
9 x 0.75 mm
41 N·m (4.1 kg-m, 30 lb-ft)
NOTE: Do not rotate the crank during inspection.
5. Remove the rod cap and bearing half and measure the widest part of the plastigage.

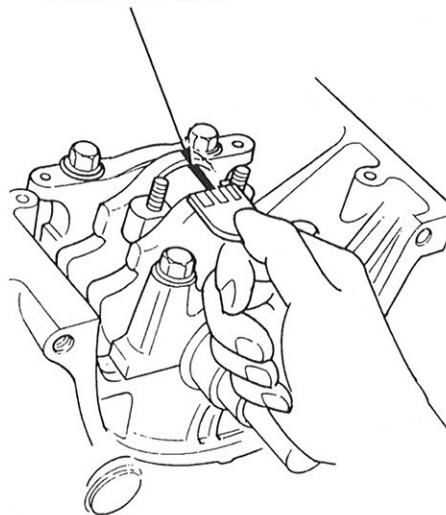
Connecting Rod Bearing Clearance:

Standard (New): 0.032–0.050 mm

(0.0013–0.0020 in.)

Service Limit: 0.060 mm (0.0024 in.)

PLASTIGAGE STRIP



6. If the plastigage measures too wide or too narrow, remove the upper half of the bearing, install a new, complete bearing with the same color code (select color as shown on next page), and recheck the clearance.

CAUTION: Do not file, shim, or scrape the bearing or the caps to adjust clearance.

7. If the plastigage shows the clearance is still incorrect, try the next larger or smaller bearing (the color listed above or below that one), and check clearance again.

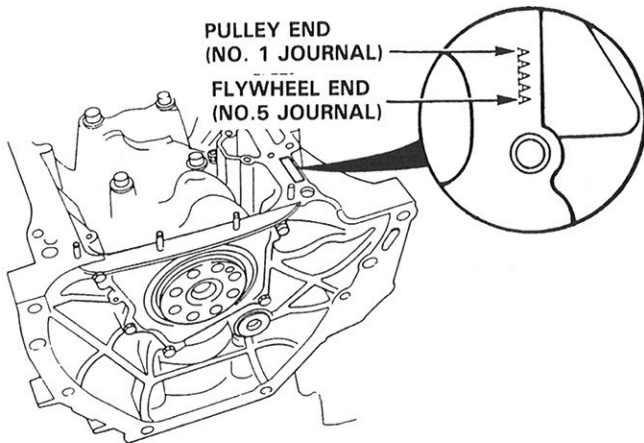
NOTE: If the proper clearance cannot be obtained by using the appropriate larger or smaller bearings, replace the crank and start over.

Main Bearings

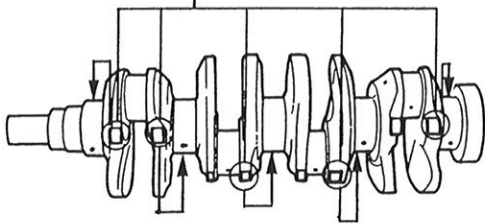
Selection

Crank Bore Code Location (Marks)

Marks have been stamped on the end of the block as a code for the size of each of the 5 main journal bores. Use them, and the numbers stamped on the crank (codes for main journal size), to choose the correct bearings.



Main Journal Code Locations (Numbers)



Bearing Identification

Color code is on the edge of the bearing → Larger crank bore

A or I	B or II	C or III	D or IIII
--------	---------	----------	-----------

→ Smaller bearing (thicker)

1 or I
2 or II
3 or III
4 or IIII

↓
Smaller main journal Smaller bearing (thicker)

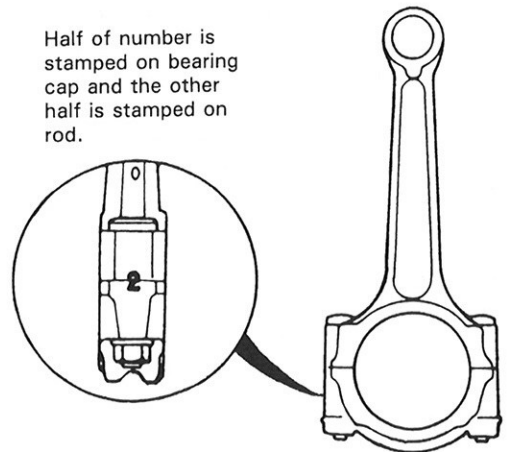
Red	Pink	Yellow	Green
Pink	Yellow	Green	Brown
Yellow	Green	Brown	Black
Green	Brown	Black	Blue

Rod Bearings

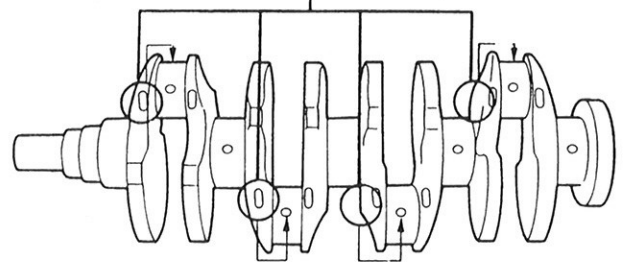
Selection

Rod Code Location (Numbers)

Numbers have been stamped on the side of each connecting rod as a code for the size of the big end. Use them, and the letters stamped on the crank (codes for rod journal size), to choose the correct bearings.



Rod journal Code Locations (Letters)



Bearing Identification

Color code is on the edge of the bearing → Larger big end bore

1	2	3	4
---	---	---	---

→ Smaller bearing (thicker)

A or I
B or II
C or III
D or IIII

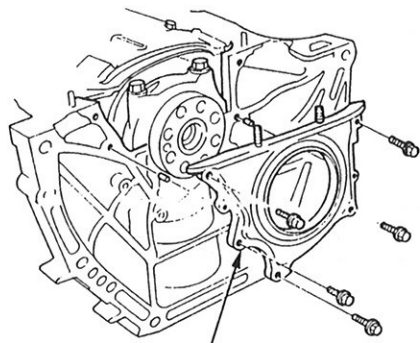
↓
Smaller rod journal Smaller bearing (thicker)

Red	Pink	Yellow	Green
Pink	Yellow	Green	Brown
Yellow	Green	Brown	Black
Green	Brown	Black	Blue

Crankshaft and Pistons

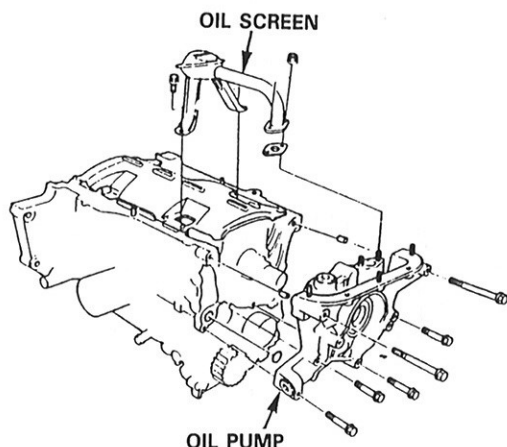
Removal

1. Remove the right side cover.



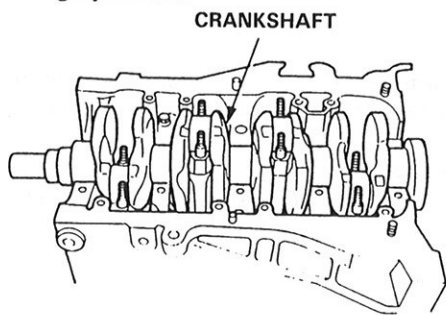
RIGHT SIDE
COVER

2. Remove the oil screen.



OIL PUMP

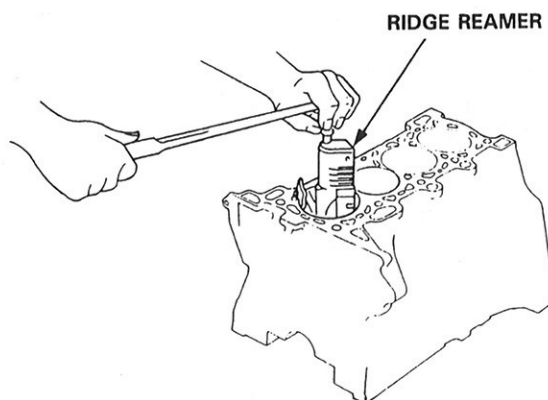
3. Remove the oil pump.
4. Remove the baffle plate.
5. Turn the crankshaft so No. 2 and 3 crankpins are at the bottom.
6. Remove the rod caps/bearings and main caps/bearings. Keep all caps/bearings in order.
7. Lift the crankshaft out of engine, being careful not to damage journals.



CRANKSHAFT

8. Remove upper bearing halves from connecting rods and set aside with their respective caps.
9. Reinstall main cap and bearings on engine in proper order.
10. If you can feel a ridge of metal or hard carbon around the top of each cylinder, remove it with a ridge reamer. Follow reamer manufacturer's instructions.

CAUTION: If the ridge is not removed, it may damage the pistons as they are pushed out.

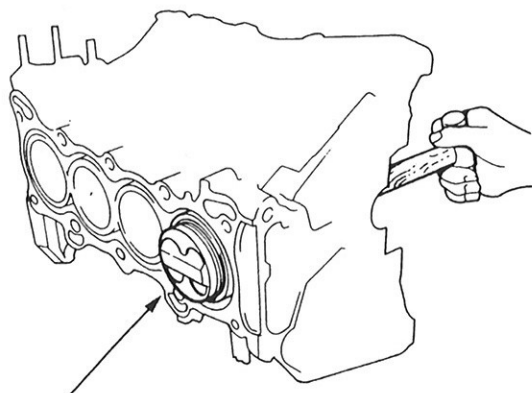


RIDGE REAMER

11. Use the wooden handle of a hammer to drive out pistons.

CAUTION:

- Care should be taken not to damage the contact surface of the metal gasket.
- When removing the piston/connecting rod, care should be taken not to hit the oil jet.
- If the oil jet nozzle is damaged or bent, replace the oil jet assembly.



12. Reinstall the rod bearings and caps after removing each piston/connecting rod assembly.
13. Mark piston/connecting rod assemblies with cylinder numbers to avoid mixup on reassembly. **NOTE:** The existing number on the connecting rod does not indicate its position in the engine, it indicates the rod bore size.

Crankshaft

Inspection

- Clean the crankshaft oil passages with pipe cleaners or a suitable brush.
- Check the keyway and threads.

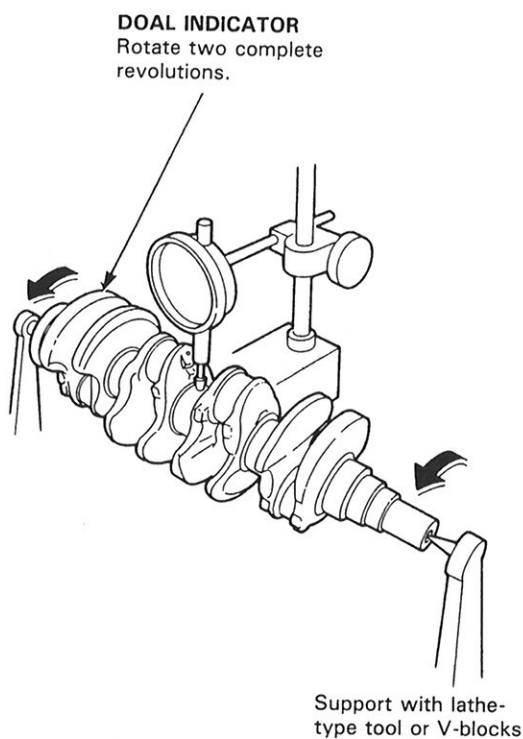
Alignment

- Measure runout on all main journals to make sure the crank is not bent.
- The difference between measurements on each journal must not be more than the service limit.

Crankshaft Total Indicate Runout:

Standard (New): 0.02 mm (0.0008 in.) max.

Service Limit: 0.03 mm (0.0012 in.)



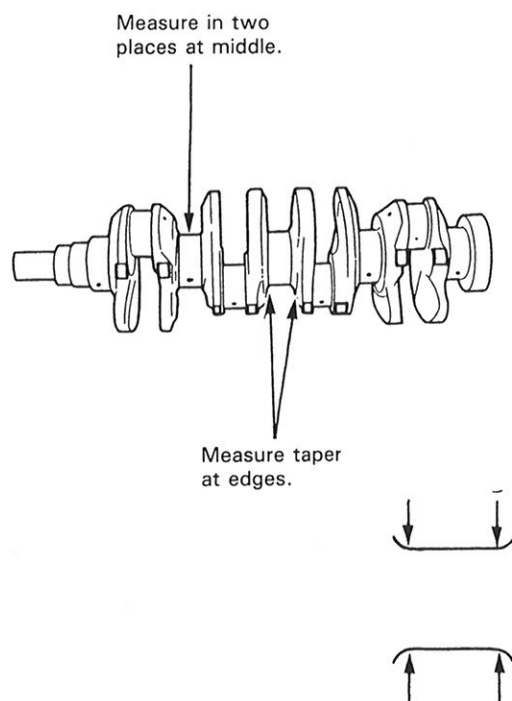
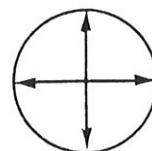
Out-of-Round and Taper

- Measure out-of-round at the middle of each rod and main journal in two places.
- The difference between measurements on each journal must not be more than the service limit.

Journal Out-of-Round:

Standard (New): 0.004 mm (0.0002 in.) max.

Service Limit: 0.006 mm (0.0002 in.)



- Measure taper at edges of each rod and main journal.
- The difference between measurements on each journal must not be more than the service limit.

Journal Taper:

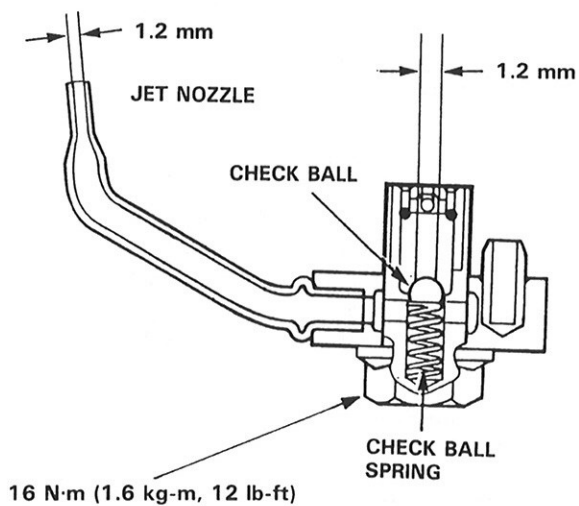
standard (New): 0.005 mm (0.0002 in.) max.

Oil Jet

Inspection

- Remove the oil jet and carry out the inspection as follows.
 - Make sure that a drill of 1.1 mm dia can go through the nozzle hole (1.2 mm dia.).
 - Insert the other end of the drill (1.1 mm dia.) from the oil intake (1.2 mm dia.) and check if the check ball moves smoothly and it has a stroke of approximately 4 mm.
 - Confirm that the check ball does not activate by the air pressure of less than 196 kPa (2.0 kg/cm², 28 psi). (Reserve of idle oil pressure)

NOTE: Replace the assembly if the oil jet nozzle is damaged or bent.



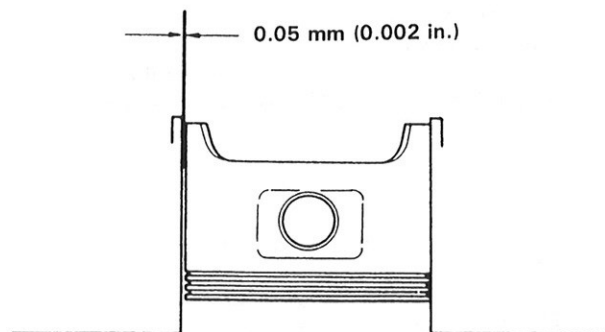
- when installing, the torque must be controlled accurately.
Torque: 16 N·m (1.6 kg-m, 12 lb-ft)

Cylinder Block

Piston-to-Block Clearance

- Make a preliminary piston-to-block clearance check with a feeler gauge:

Service Limit: 0.05 mm (0.002 in.)



If the clearance is near or exceeds the service limit, inspect the piston and cylinder block for excessive wear.

To confirm the feeler gauge check, further measurement with a micrometer will be necessary.

- Calculate difference between cylinder bore diameter on page 4-12 and piston diameter.

Piston-to-Cylinder Clearance:

Standard (New): 0.010–0.035 mm
(0.0004–0.0014 in.)

Service Limit: 0.05 mm (0.002 in.)

Piston

Inspection

1. Check the piston for distortion or cracks.

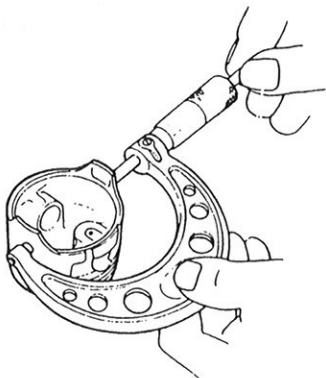
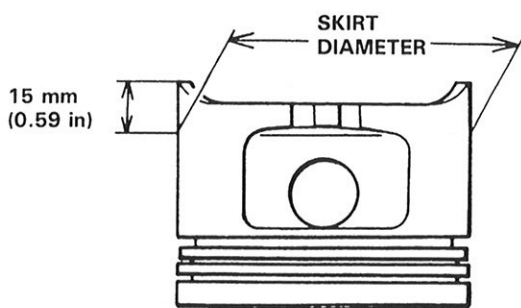
NOTE: If cylinder is bored, an oversized piston must be used.

2. Measure piston diameter at a point 15 mm (0.59 in.) from bottom of skirt.

Piston Diameter:

Standard (New): 80.98–80.99 mm
(3.1882–3.1886 in.)

Service Limit: 80.97 mm (3.1879 in.)



Oversize Piston Diameter

0.25: 81.23–81.24 mm
(3.1980–3.1984 in.)

3. Check the piston pin-to-piston clearance. Coat the piston pin with engine oil. It should then be possible to push the piston pin into the piston hole with thumb pressure.

Piston Pin-to-Piston Clearance:

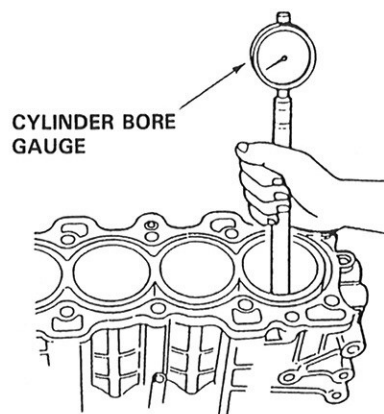
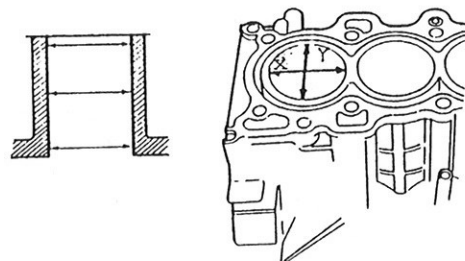
Service Limit: 0.010–0.022 mm
(0.0004–0.0009 in.)

Cylinder Block

Inspection

CAUTION: Care should be taken not to damage the contact surface of the metal gasket.

1. Measure wear and taper in directions X and Y at three levels in each cylinder as shown.



Cylinder Bore Size

Standard (New):

X: 81.000–81.020 mm (3.1890–3.1898 in.)

Y: 81.000–81.015 mm (3.1890–3.1896 in.)

Y Measure Point: 50–55 mm (1.97–2.17 in) from block top surface.

Service Limit: 81.070 mm (3.1917 in.)

Oversize

0.25: 81.25–81.45 mm (3.1988–3.2067 in.)

Bore Taper

Limit: (Difference between first and third measurement) 0.05 mm (0.002 in.)

- If measurements in any cylinder are beyond Oversize Bore Service Limit, replace the block.
- If block is to be rebored, refer to Piston Clearance Inspection (page 4-11) after reboring.

NOTE: Scored or scratched cylinder bores must be honed.

Out-of-Round

Service Limit: 0.05 mm (0.002 in.)

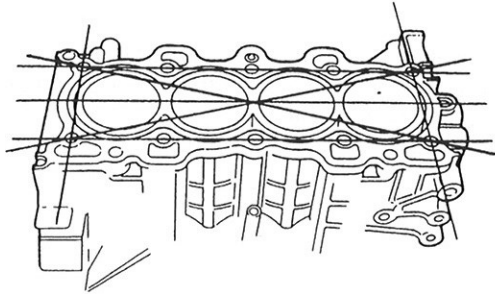
(cont'd)

Cylinder Block

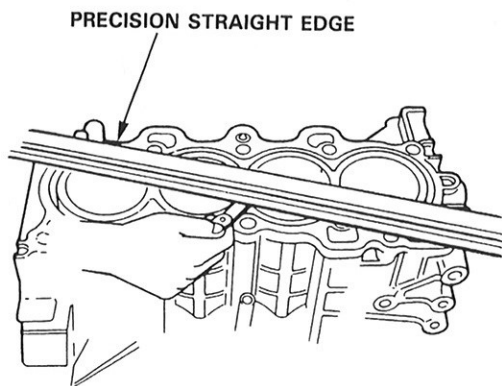
Inspection (cont'd)

2. Check the top of the block for warpage. Measure along the edges and across the center as shown.

SURFACES TO BE MEASURED

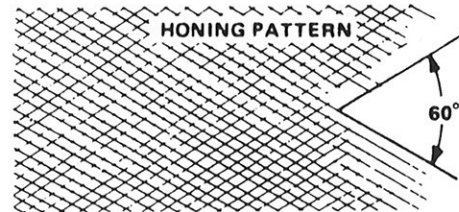


Engine Block Warpage:
Standard (New): 0.05 mm (0.0020 in.)
Service Limit: 0.08 mm (0.0031 in.)



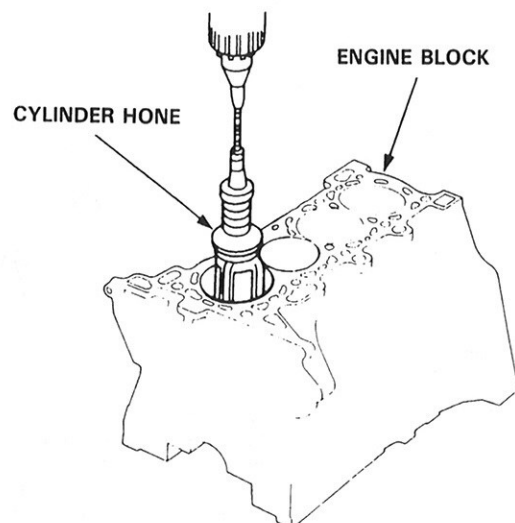
Bore Honing

1. Measure cylinder bores as shown on page 4-12. If the block is to be re-used, hone the cylinders and remeasure the bores.
2. Hone cylinder bores with honing oil and a fine (400 grit) stone in a 60 degree cross-hatch pattern.



3. When honing is complete, thoroughly clean the engine block of all metal particles. Wash the cylinder bores with hot soapy water, then dry and oil immediately to prevent rusting.
4. If Scoring or scratches are still present in cylinder bores after honing to service limit, rebore the engine block.

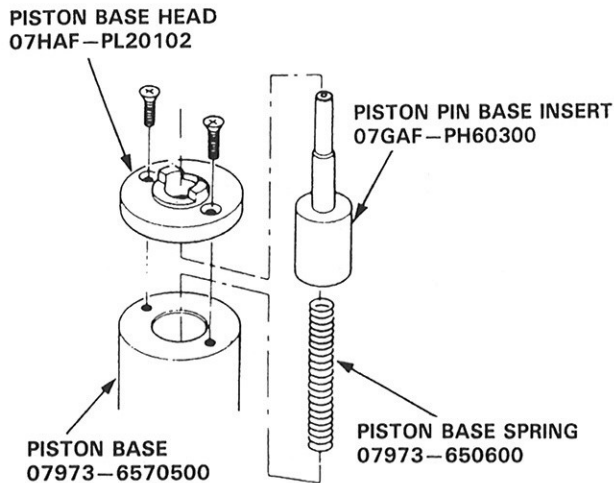
NOTE: Some light vertical scoring and scratching is acceptable if it is not deep enough to catch your fingernail and does not run the full length of the bore.



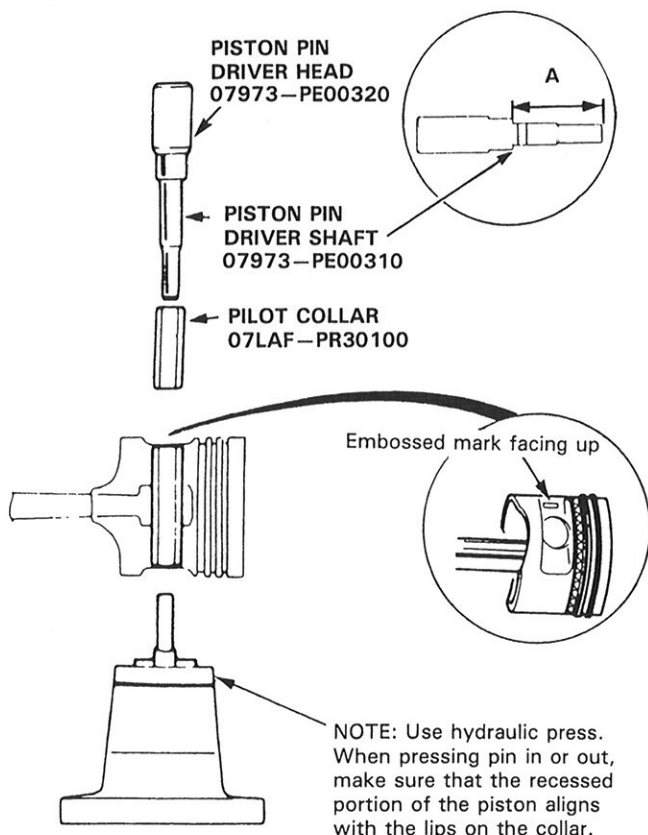
Piston Pins

Removal

1. Assemble the Piston Pin Dis/assembly Tool as shown.



2. Adjust the length A of piston pin driver.
A: 51.7 mm (2.04 in)



3. Place the piston on the piston base and press the pin out with a hydraulic press.

Connecting Rods

Selection

Each rod is sorted into one of four tolerance ranges (from 0 to 0.024 mm, in 0.006 mm increments) depending on the size of its big end bore. It's then stamped with a number 1, 2, 3 or 4 indicating that tolerance. You may find any combination of 1, 2, 3 or 4 in any engine.

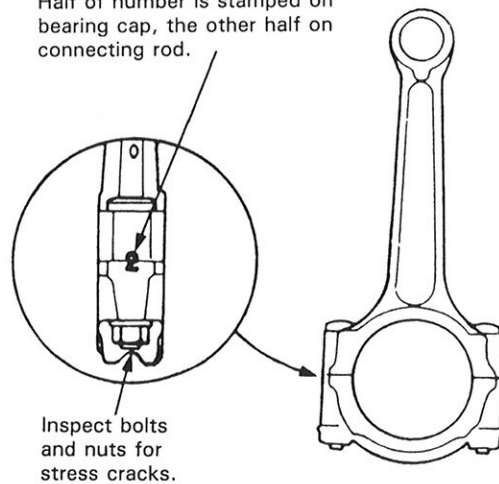
Normal Bore Size: 48 mm (1.89 in.)

NOTE:

- Reference numbers are for big end bore size and do NOT indicate the position of rod in engine.
- Inspect connecting rod for cracks and heat damage.

CONNECTING ROD BORE REFERENCE NUMBER

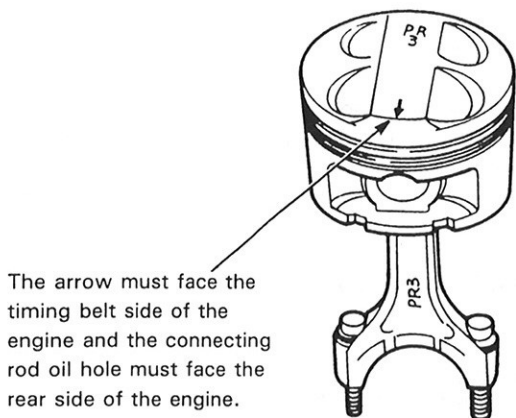
Half of number is stamped on bearing cap, the other half on connecting rod.



Piston Pins

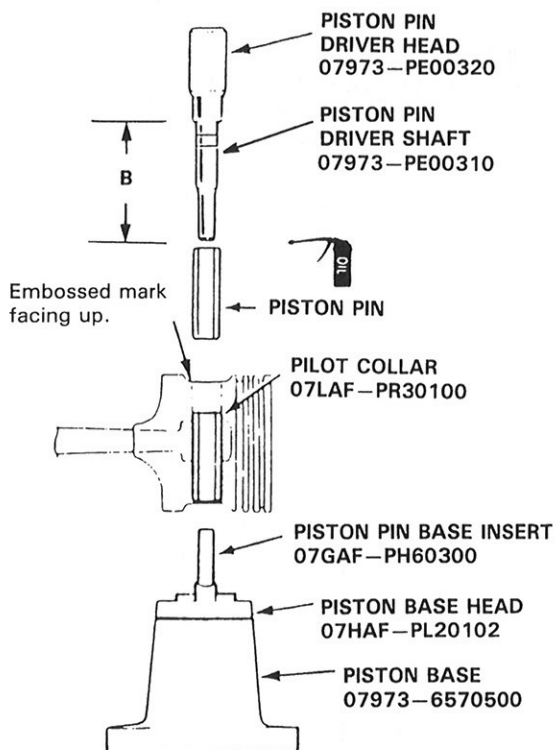
Installation

1. Use a hydraulic press for installation.
 - When pressing pin in or out, be sure you position the recessed flat on the piston against the lugs on the base attachment.



The arrow must face the timing belt side of the engine and the connecting rod oil hole must face the rear side of the engine.

2. Adjust the length B of piston pin driver.
B: 51.7 mm (2.04 in)



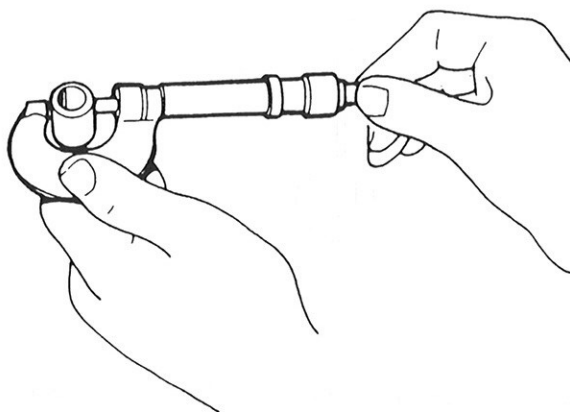
NOTE: Install the assembled piston and rod with the oil hole facing the rear of the engine.

Inspection

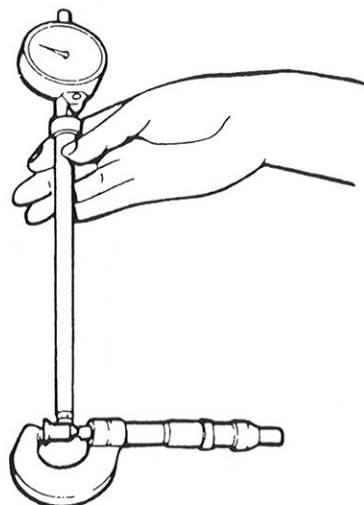
1. Measure the diameter of the piston pin.

Piston Pin Diameter:
Standard (New):
 20.994–21.000 mm (0.8265–0.8268 in)
Overize:
 20.997–21.003 mm (0.8267–0.8269 in)

NOTE: All replacement piston pins are overize.



2. Zero the dial indicator to the piston pin diameter.



(cont'd)

Piston Pins

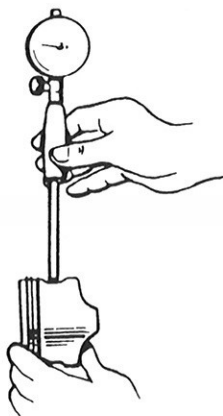
Inspection (cont'd)

3. Measure the piston pin-to-piston clearance.

NOTE: Check the piston for distortion or cracks.

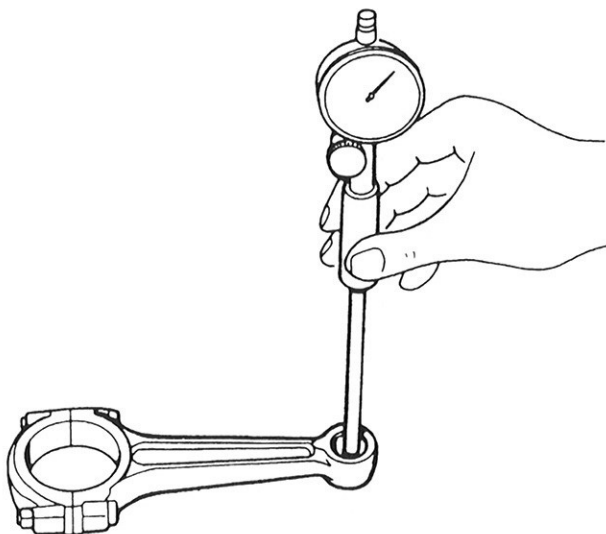
If the piston pin clearance is greater than 0.024 mm (0.0009 in.), re-measure using an oversize piston pin.

Piston Pin-to-Piston Clearance:
Service Limit: 0.010–0.022 mm
 (0.0004–0.0009 in.)



4. Check the difference between piston pin diameter and connecting rod small end diameter.

Piston Pin-to-Connecting Rod Interference:
Standard (New): 0.013–0.032 mm
 (0.0005–0.0013 in.)



Piston Rings

End Gap

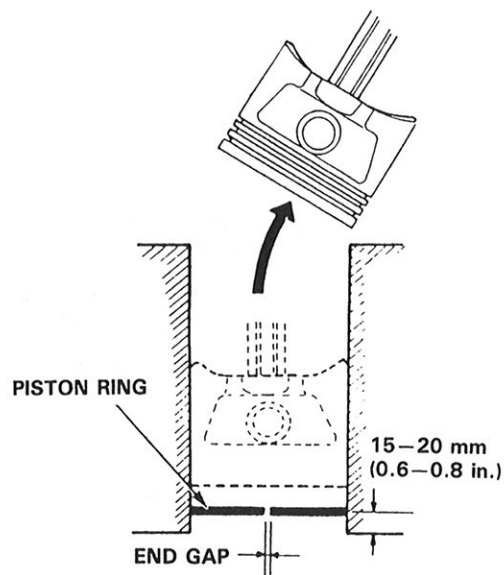
1. Using a piston, push a new ring into the cylinder bore 15–20 mm (0.6–0.8 in.) from the bottom.
2. measure the piston ring end-gap with a feeler gauge:
 - If the gap is too small, check to see if you have the proper rings for your engine.
 - If the gap is too large, re-check the cylinder bore diameter against the wear limits on page 4-12.
 If the bore is over limit, the engine block must be reboored.

Piston Ring End-Gap:

Top Ring
Standard (New): 0.20–0.35 mm
 (0.008–0.014 in.)
Service Limit: 0.6 mm (0.02 in.)

Second Ring
Standard (New): 0.40–0.55 mm
 (0.016–0.022 in.)
Service Limit: 0.7 mm (0.03 in.)

Oil Ring
Standard (New): 0.20–0.45 mm
 (0.008–0.018 in.)
TEIKOKU PISTON RING made
0.20–0.50 mm
 (0.008–0.020 in.)
RIKEN made
Service Limit: 0.8 mm (0.03 in.)



Replacement

1. Using ring expander, remove old piston rings.
2. Clean all ring grooves thoroughly.

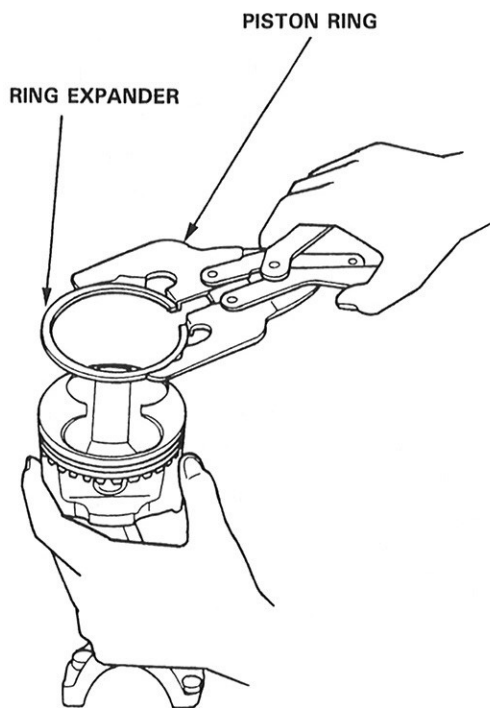
NOTE: Use squared-off broken ring, or file down blade on ring groove cleaner to fit (top ring is 1.0 mm wide; second rings is 1.2 mm wide; oil ring is 2.8 mm wide).

CAUTION: Do not use a wire brush to clean ring lands, or cut ring lands deeper with cleaning tool.

NOTE: If piston is to be separated from connecting rod, do not install new rings yet.

3. Install new rings in proper sequence and position (page 4-18).

NOTE: Do not re-use old piston rings.



Land Clearance

After installing a new set of rings, measure ring-to-land clearances.

Top Ring Clearance:

Standard (New): 0.045–0.070 mm
(0.0018–0.0028)

Service Limit: 0.13 mm (0.005 in.)

Second Ring Clearance:

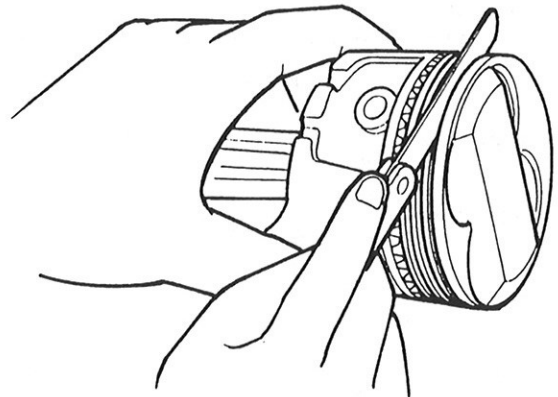
Standard (New): 0.045–0.070 mm
(0.0018–0.00281 in)

TEIKOKU PISTON RING made
0.040–0.065 mm

(0.0015–0.0026 in)

RIKEN made

Service Limit: 0.13 mm (0.005 in.)

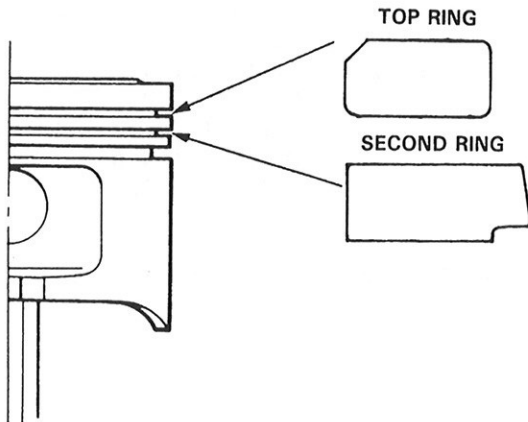


Piston Rings

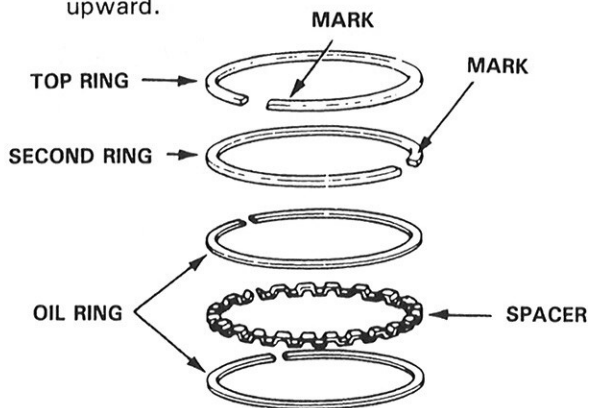
Alignment

1. Install the rings as shown on page 4-18.

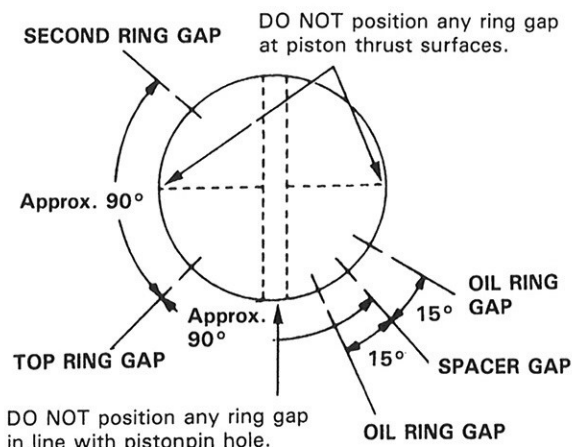
Identify top and second rings by the chamfer on the edge, and make sure they are in proper grooves on piston.



2. Rotate the rings in grooves to make sure they do not bind.
3. The manufacturing marks must be facing upward.



4. Position the ring end gaps as shown:



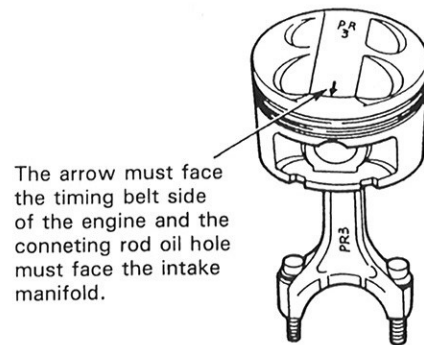
Pistons

Installation

Before installing the piston, apply a coat of engine oil to the ring grooves and cylinder bores.

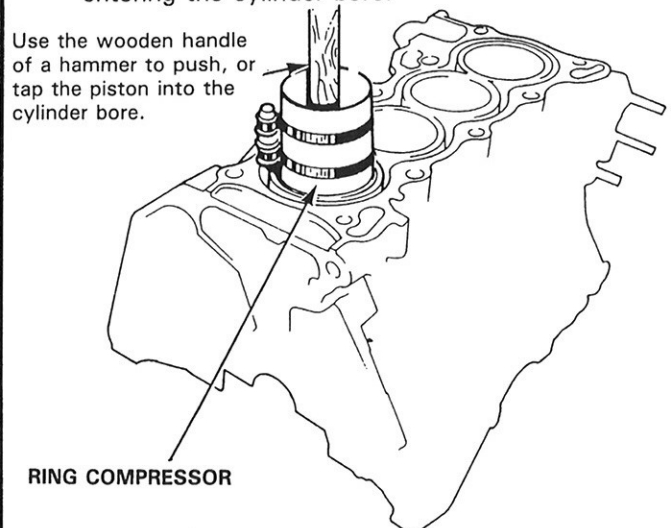
1. If the crankshaft is already installed:
 - Remove the connecting rod caps, then slip short sections of rubber hose over the threaded ends of the connecting rod bolts.
 - Install the ring compressor, check that the bearing is securely in place, then position the piston in the cylinder and drive it in using the wooden handle of a hammer. Stop after the ring compressor pops free and check the connecting rod-to-crank journal alignment before driving rod into place.
 - Install the rod caps with bearings, and torque them to 41 N·m (4.1 kg-m, 30 lb-ft).

2. If the crankshaft is not installed:
 - Remove the rod caps and bearings, install the ring compressor, then position the piston in the cylinder and drive it in using the wooden handle of a hammer.
 - Position all pistons at top dead center.




The arrow must face the timing belt side of the engine and the connecting rod oil hole must face the intake manifold.

NOTE: Maintain downward force on ring compressor to prevent rings from expanding before entering the cylinder bore.



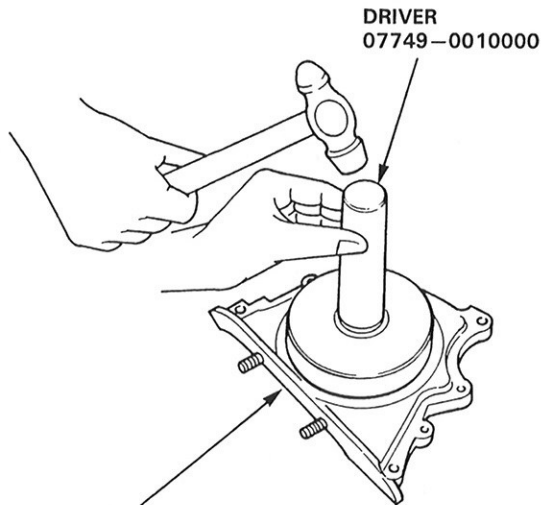
Oil Seal

Installation

 The seal surface on the block should be dry. Apply a light coat of oil to the crankshaft and to the lip of seal.

1. Drive in flywheel end seal against R. side cover.

NOTE: Drive in flywheel end seal squarely.

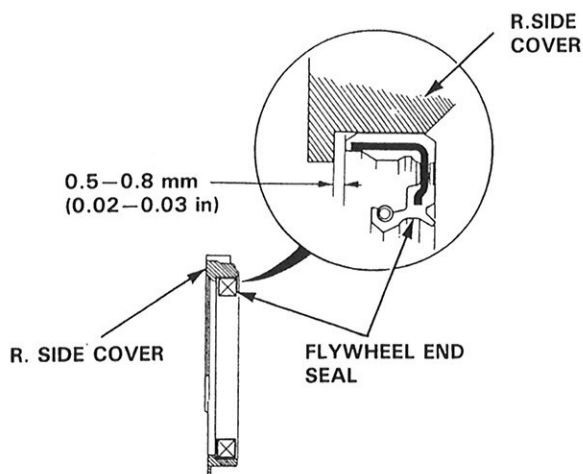


DRIVER ATTACHMENT
07948-SB00101

Install seal with the part number side facing out.

2. Confirm clearance is equal all the way around, with a feeler gauge.

Clearance: 0.5–0.8 mm (0.02–0.03 in)




0.5–0.8 mm
(0.02–0.03 in)

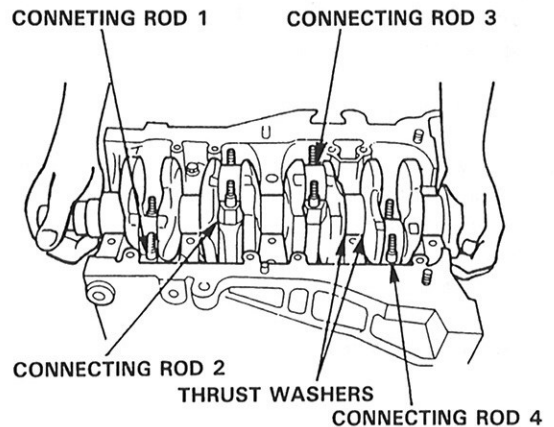
NOTE: Refer to page 5-10 for steps on the oil pump side oil seal.

Crankshaft

Installation

 Before installing the crankshaft, apply a coat of engine oil to the main bearings and rod bearings.

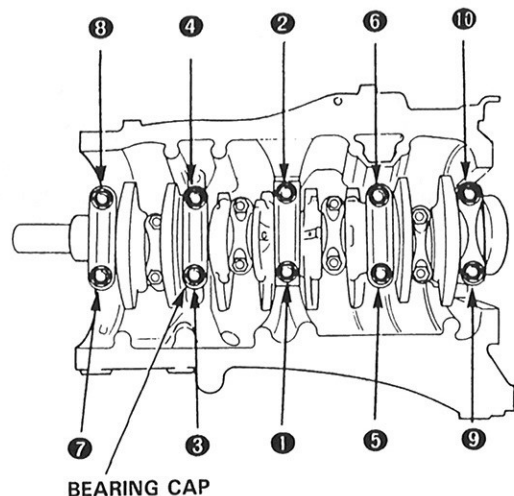
1. Insert bearing halves in the engine block and connecting rod.
2. Hold the crankshaft so rod journals for cylinder No. 2 and No. 3 are straight down.
3. Lower the crankshaft into the block, seating the rod journals into connecting rods No. 2 and No.3 and install rod caps and nuts finger tight.



4. Rotate the crankshaft clockwise, seat journals into connecting rods No. 1 and No.4, and install the rod caps and nuts finger tight.
5. Install the thrust washers, main bearing halves caps, check clearance with plastigage (page 4-7), then torque the bolts. Oil thrust washer surfaces.

TORQUE SEQUENCE

12 x 1.5 mm 78 N·m (7.8 kg-m, 56 lb-ft)



NOTE: The No.3 bearing bolts are longer bolts.

(cont'd)

Crankshaft

Installation (cont'd)

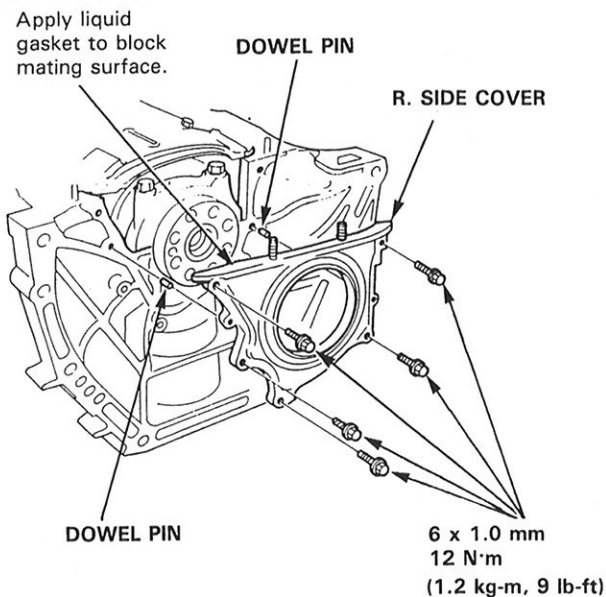
6. Check the rod bearing clearance with plastigage (page 4-7), then torque the nuts.
9 x 0.75 mm
41 N·m (4.1 kg-m, 30 lb-ft)

NOTE: Reference numbers on connecting rod are for big-end bore tolerance and do NOT indicate the position of piston in engine.

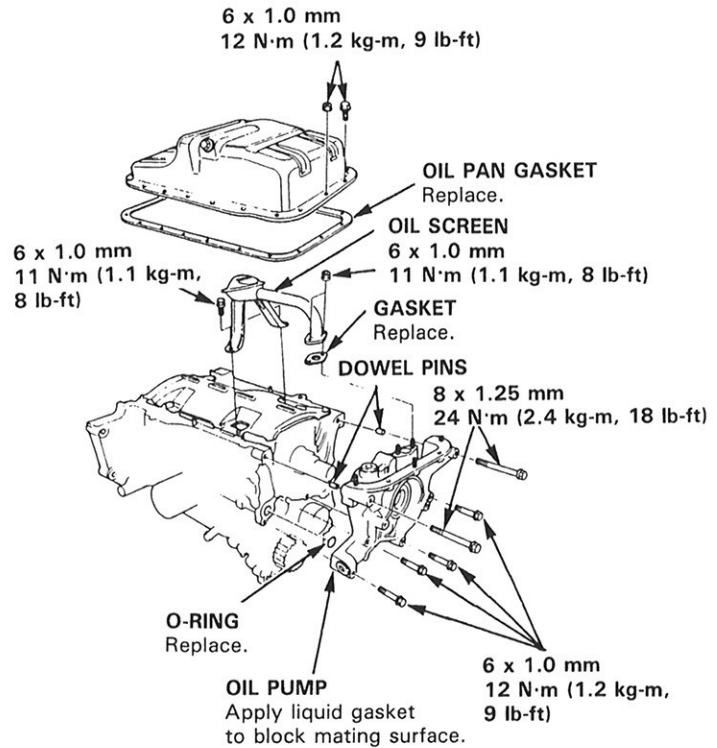
CAUTION: Whenever any crankshaft or connecting rod bearings are replaced, after reassembly run the engine at idling speed until it reaches normal operating temperature, then continue to run for approximately 15 minutes.

7. Install the baffle plate.
8. Apply non-hardening liquid gasket to the block mating surface of the right side cover and oil pump case, and install them on the engine block.
- Refer to page 4-21, applying areas of liquid gasket.

R. SIDE COVER:



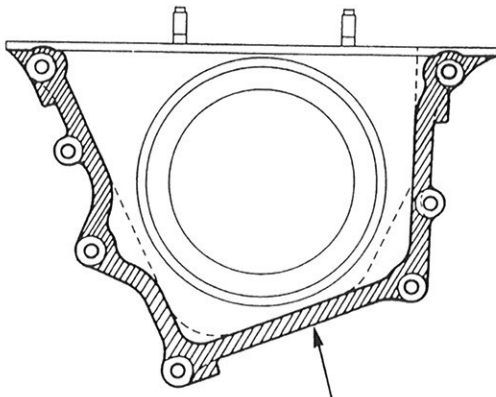
OIL PUMP:



NOTE:

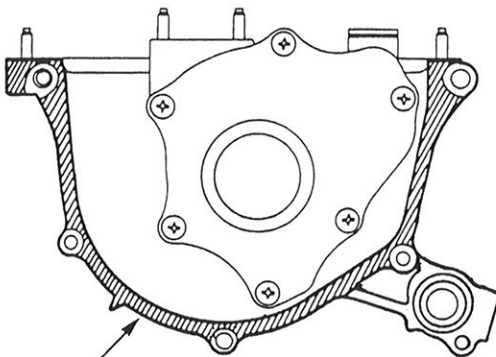
- Use Part No. 0Y740-99986 for the liquid gasket.
- Check that the mating surfaces are clean and dry before applying liquid gasket.
- Apply liquid gasket by starting with an even bend, centered between edges of the mating surface.
- To prevent leakage of oil, apply liquid gasket to the inner threads of the bolt holes.

R. SIDE COVER:



Apply liquid gasket to shaded area.

OIL PUMP:



Apply liquid gasket to shaded area

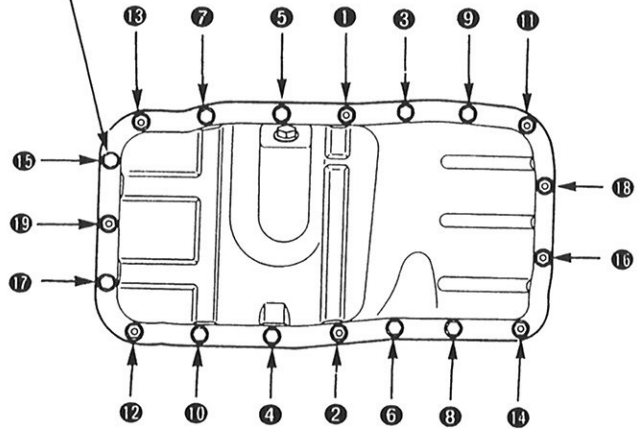
- Do not allow the sealant to dry before assembly.
- Wait at least 30 minutes after assembly before filling the engine with oil.

8. Install the oil screen.

9. Install the oil pan, then torque to the oil pan bolts and nuts.

TORQUE SEQUENCE

6 x 1.0 mm
12 N·m (1.2 kg-m, 9 lb-ft)



Engine Lubrication

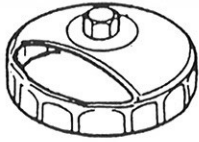
Standards and Service Limits	5-2
Special Tools	5-3
Illustrted Index	5-4
Oil Level Inspection	5-5
Engine Oil Replacement	5-5
Oil Filter Replacement	5-6
Oil Pressure Test	5-7
Oil Pump Overhaul	5-8
Oil Pump Removal/Inspection	5-9

Standard and Service Limits

	MEASUREMENT		STANDARD (NEW)	SERVICE LIMIT
Engine oil	Capacity ℓ (US qt, Imp qt)		4.8 (5.1, 4.2) For engine disassembly 4.0 (4.2, 3.6) For oil change, including oil filter	
Oil pump	Displacement ℓ (US gal, Imp gal)/min @ min ⁻¹ (rpm)		71 (1.87, 1.56) @ 7,600	
	Inner-to-outer rotor radial clearance		0.04–0.16 (0.0016–0.0063)	0.2 (0.0079)
	Pump body-to-rotor radial clearance		0.10–0.19 (0.0039–0.0075)	0.2 (0.0079)
	Pump body-to rotor side clearance		0.02–0.07 (0.0008–0.0026)	0.15 (0.0059)
Relief valve	Pressure setting 80 °C (176F) kPa (kg/cm ² , psi)	Idle	69 (0.7, 10) min.	
		3,000 min ⁻¹ (rpm)	343 (3.5, 50) min.	

Special Tools

Ref. No.	Tool Number	Description	Q'ty	Remarks
①	07912-6110001	Oil Filter Socket Wrench	1	
②	07406-0030000	Oil Pressure Gauge Attachment	1	
③	07746-0010400	Attachment, 52 x 55 mm	1	
④	07749-0010000	Driver	1	



①



②



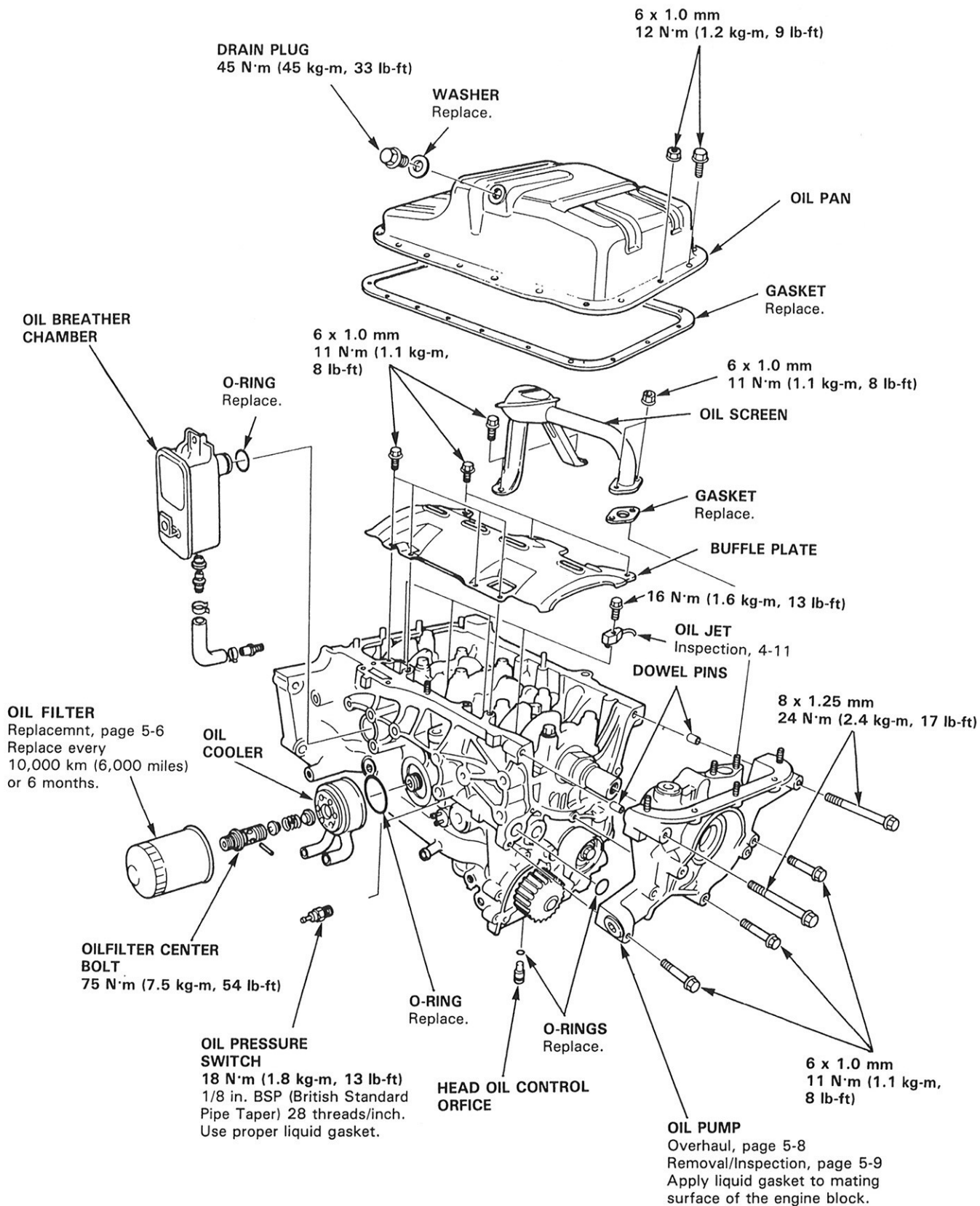
③



④

Lubrication

Illustrated Index

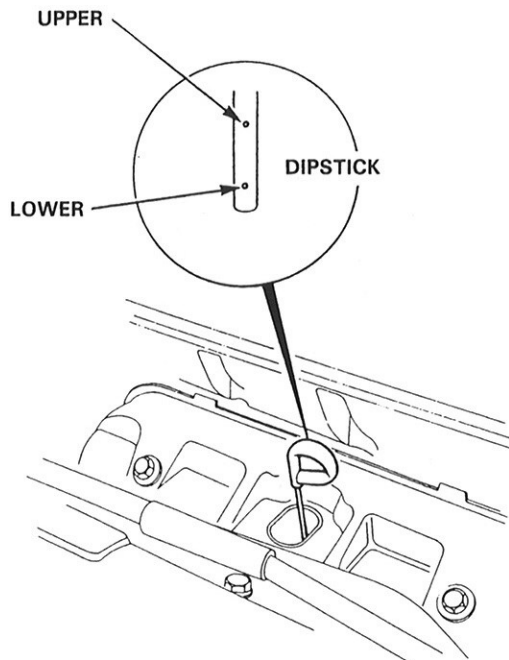


Oil level

Inspection

1. Check engine oil with the engine off and the car parked on level ground.
2. Make certain that the oil level indicated on the dipstick is between the upper and lower marks.
3. If the level has dropped close to the lower mark, add oil until it reaches the upper mark.

CAUTION: Insert the dipstick carefully to avoid bending it.

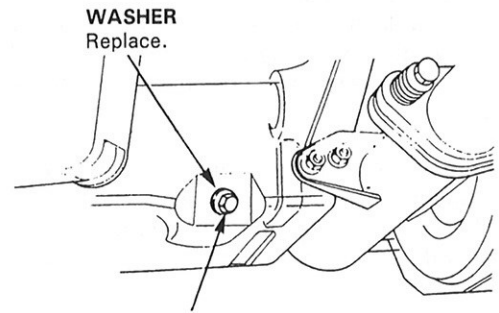


Engine Oil

Replacement

1. Warm up the engine.
2. Drain the engine oil.

NOTE: Remove the filler cap to speed draining.

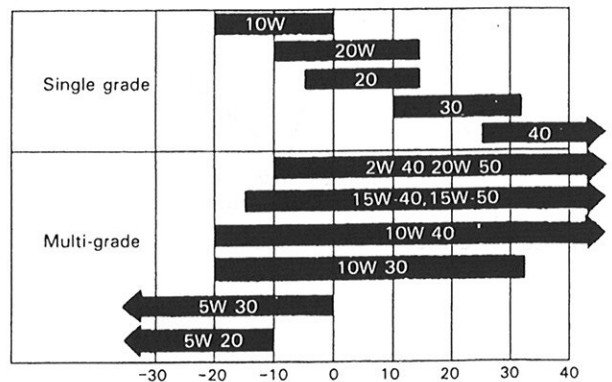


OIL PAN DRAIN PLUG
45 N·m (4.5 kg-m, 33 lb-ft)

3. Reinstall the drain plug with a new washer, and refill with the recommended oil.

Capacity	4.8 l (5.1 US qt, 4.2 Imp qt) at engine disassembly.
	4.0 l (4.2 US qt, 3.5 Imp qt) at oil change
Change Interval	Every 10,000 km (6,000 miles) or 6 months which ever comes first.

Recommended Engine Oil
(SE SF or SG Grade 10W-30 only)



Expected Ambient Temperature before next oil change

NOTE: Oil filter should be replaced at each oil change.

Oil Filter

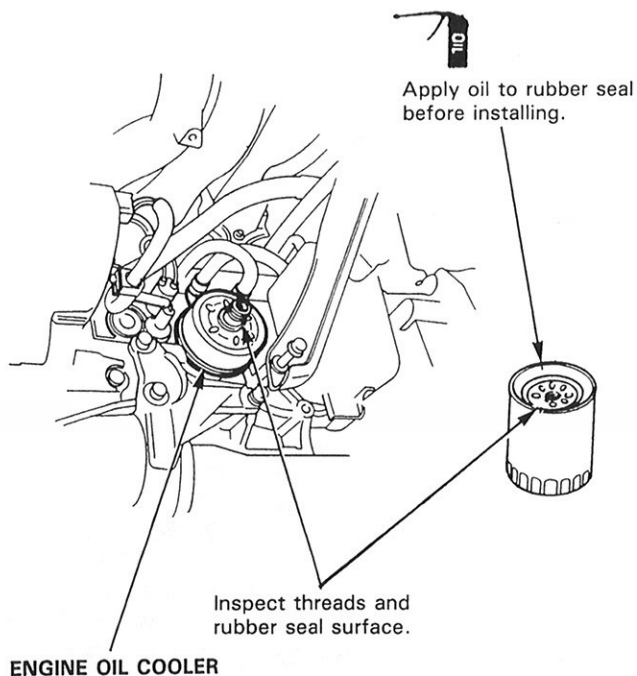
Replacement

▲ WARNING After the engine has been run, the exhaust pipes will be hot; be careful when working around the exhaust manifold.

CAUTION: Used engine oil may cause skin cancer if repeatedly left in contact with the skin for prolonged periods. Although this is unlikely unless you handle used oil on a daily basis, it is still advisable to thoroughly wash your hands with soap and water as soon as possible after handling used oil.

1. Remove the oil filter with the special tool.
2. Inspect the threads and rubber seal on the new filter. Wipe off the filter seat on the engine oil cooler and apply a light coat of oil to the filter rubber seal.

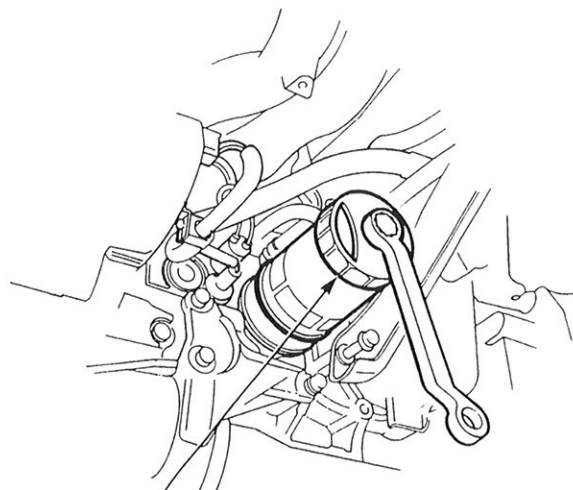
NOTE: Use only filters with a built-in bypass system.



3. Install the oil filter by hand.
4. After the rubber seal is seated, tighten the oil filter clockwise with the special tool.

Tighten: 7/8 turn clockwise.
Tightening torque: 22 N·m (2.2 kg-m, 16 lb-ft)

CAUTION: Installation other than the above procedure could result in serious engine defects due to oil leakage.



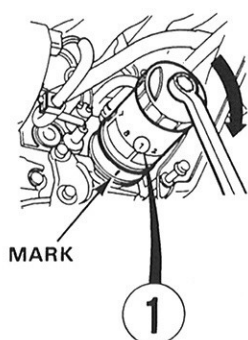
OIL FILTER SOCKET
 07912-6110001

Oil Pressure

Eight numbers (1 to 8) are printed on the surface of the filter.

The following explains the procedure for tightening filters using these numbers.

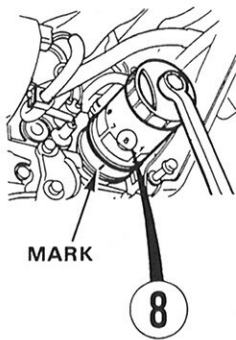
- 1) Make a mark on the cylinder block under the number that shows at the bottom of the filter when the rubber seal is seated.
- 2) Tighten the filter by turning it clockwise seven numbers from the marked point. For example, if a mark is made under the number 2 when the rubber seal is seated, the filter should be tightened until the number 1 aligns with the marked point.



MARK

1

Number when rubber seal is seated.



MARK

8

Number after tightening.

Number when rubber seal is seated	1	2	3	4	5	6	7	8
Number after tightening	8	1	2	3	4	5	6	7

5. After installation, fill the engine with oil up to the specified level, run the engine for more than 3 minutes, then check for oil leakage.

Test

If the oil pressure warning light stays on with the engine running, check the engine oil level. If the oil level is correct:

1. Remove the oil pressure switch and install an oil pressure gauge.
2. Start the engine and allow to reach operating temperature (fan comes on at least twice).
3. pressure should be:

Engine Oil Pressure:

AT idle:

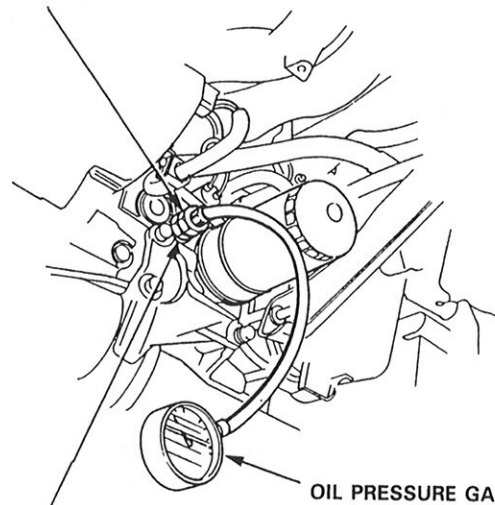
698 kPa (0.7 kg/cm², 10 psi) min.

At 3,000 min⁻¹ (rpm):

343 kPa (3.5 kg/cm², 50 psi) min.

- If oil pressure is within specifications, replace oil pressure sender and recheck.
- If oil pressure is NOT within specifications, inspect the oil pump (page 5-9).

OIL PRESSURE
GAUGE ATTACHMENT
07406-0030000



OIL PRESSURE SWITCH
MOUNTING HOLE

OIL PRESSURE GAUGE

NOTE: Apply liquid gasket to the threads of the oil pressure switch when installing.

Oil Pump

Overhaul

NOTE:

- Use new O-rings when reassembling.
- Apply oil to O-rings before installation.
- Check the rotors are moved smoothly, after reassembling.

6 x 1.0 mm
6 N·m (0.6 kg-m, 4 lb-ft)

OUTER ROTOR
Inspection, page 5-9

INNER ROTOR
Inspection, page 5-9

O-RING
Replace.

6 x 1.0 mm
11 N·m (1.1 kg-m, 8 lb-ft)

PUMP COVER

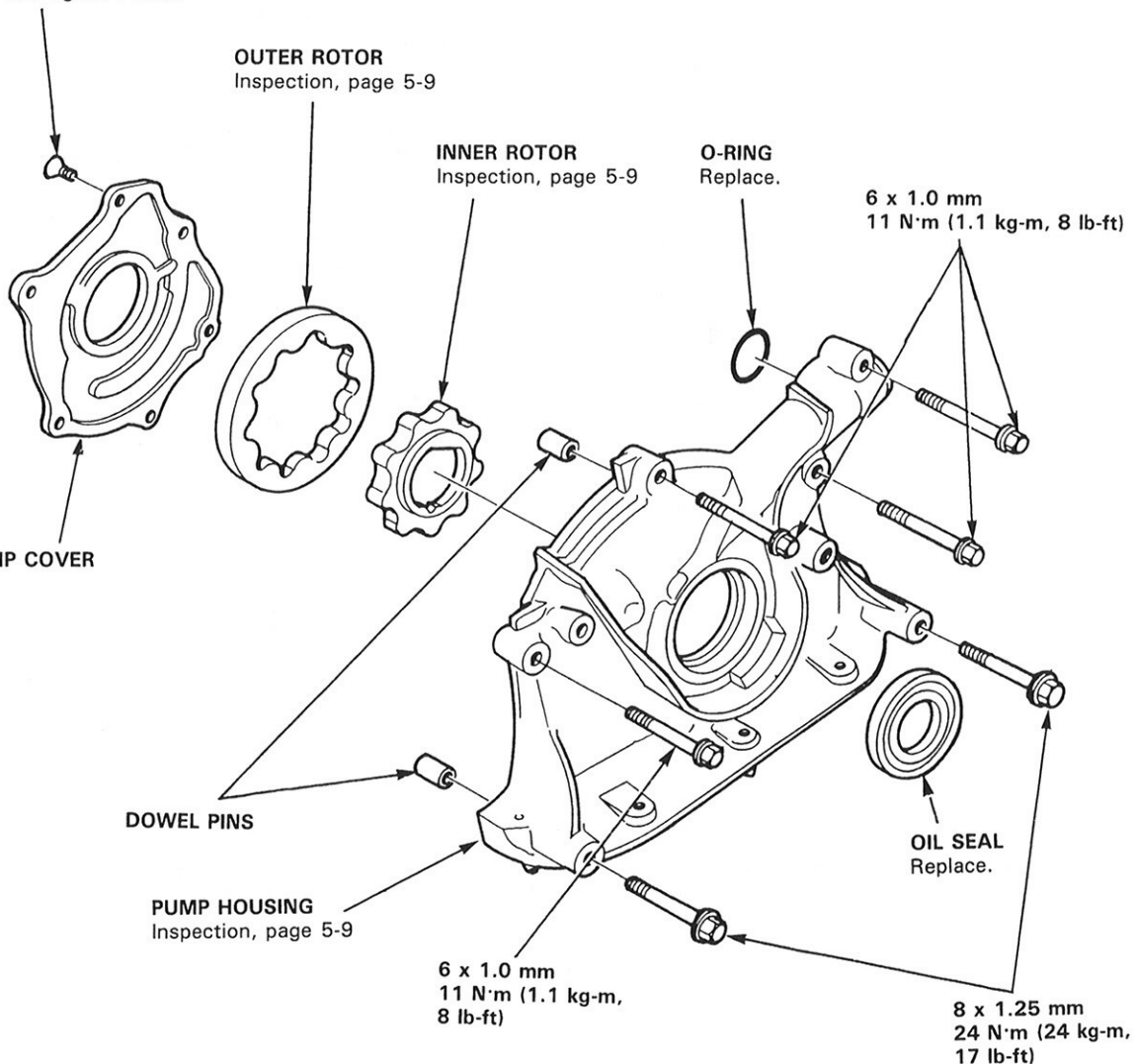
DOWEL PINS

PUMP HOUSING
Inspection, page 5-9

6 x 1.0 mm
11 N·m (1.1 kg-m,
8 lb-ft)

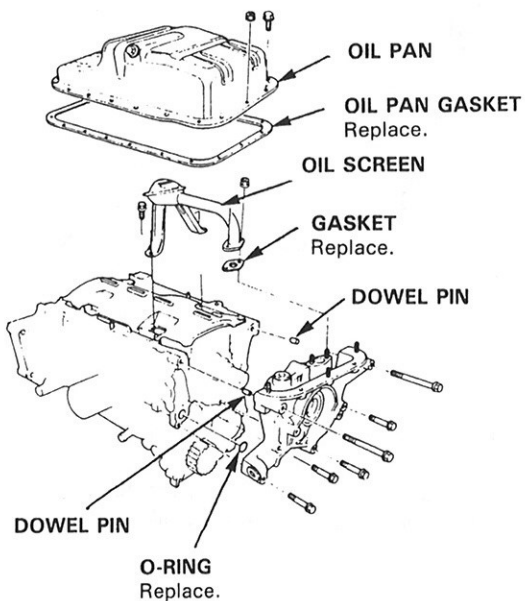
OIL SEAL
Replace.

8 x 1.25 mm
24 N·m (24 kg-m,
17 lb-ft)



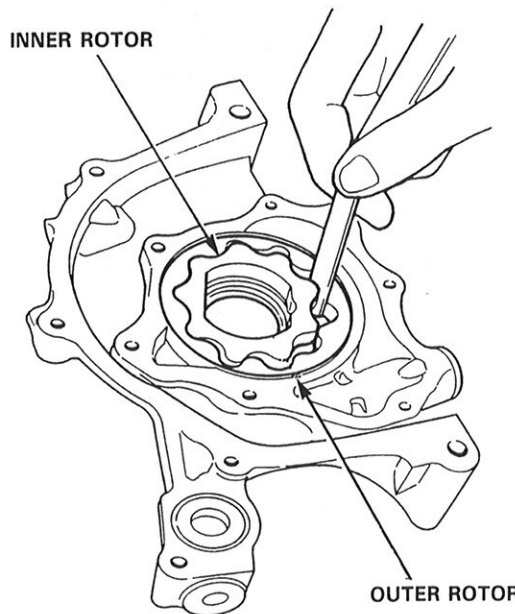
Removal/Inspection

1. Drain the engine oil.
2. Turn the crankshaft and align the white groove on the crankshaft pulley with the point on the timing belt cover.
3. Remove the valve cover and timing belt upper cover.
4. Remove the alternator belt.
5. Remove the crankshaft pulley and remove the timing belt lower cover.
6. Remove the timing belt and the drive pulley.
7. Remove the oil pan.
8. Remove the oil screen.
9. Remove the mount bolts and the oil pump assembly.



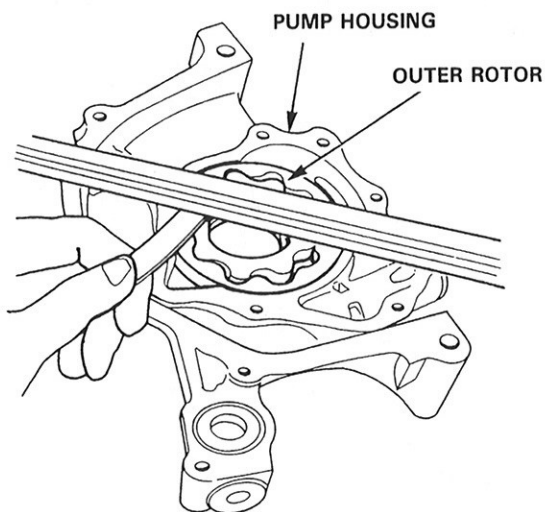
10. Remove the screws from the pump housing, then separate the housing and cover.
11. Check the radial clearance on the pump rotor.

Inner Rotor-to-Outer Rotor Radial Clearance
Standard (New): 0.04–0.16 mm
0.001–0.006
Service Limit: 0.2 mm (0.008 in.)



12. Check the axial clearance on the pump rotor.

Housing-to-Rotor Axial Clearance
Standard (New): 0.02–0.07 mm
(0.001–0.003 in.)
Service Limit: 0.15 mm (0.006 in.)



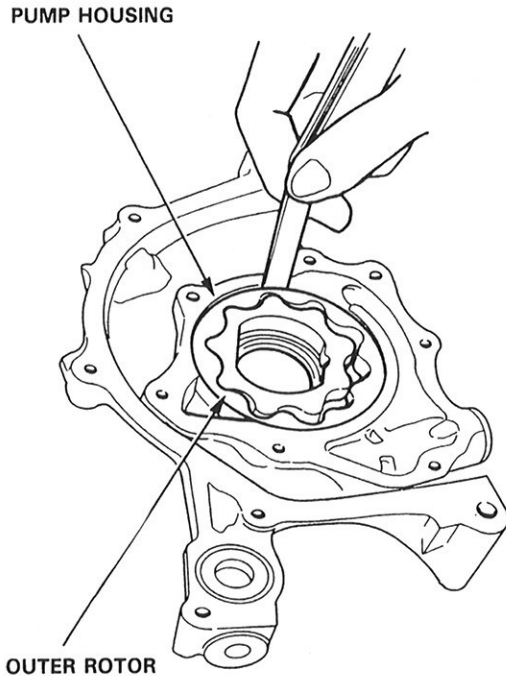
(cont'd)

Oil Pump

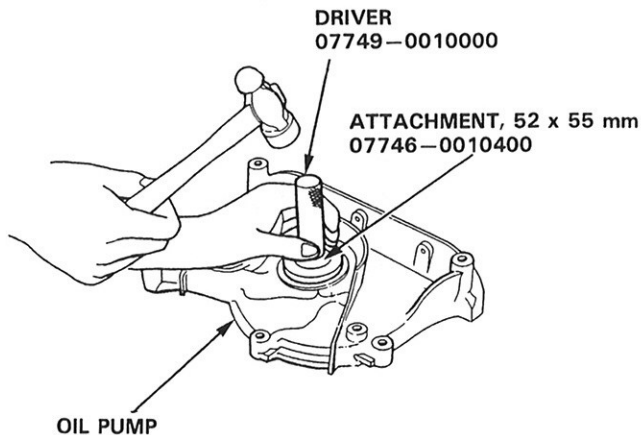
Removal/Inspection (cont'd)

13. Check the radial clearance between the housing and the outer rotor.

Housing-to-Rotor Radial Clearance
Standard (New): 0.10–0.19 mm
(0.004–0.007 in.)
Service Limit: 0.20 mm (0.008 in.)



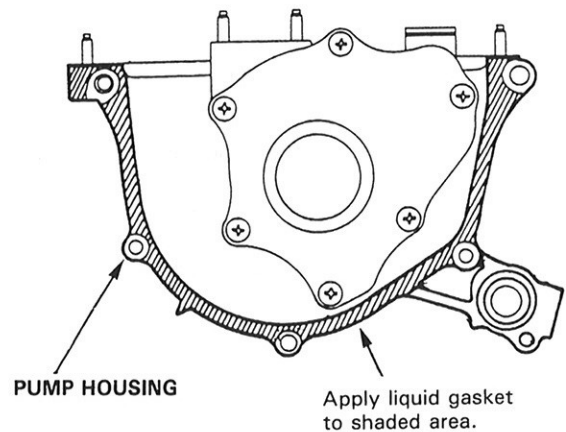
14. Inspect both rotors and pump housing for scoring or other damage. Replace parts as necessary.
15. Remove the old oil seal from the oil pump.
16. Gently tap in the new oil seal until the tool bottoms on the pump.



17. Reassemble the oil pump, applying locking fluid to the pump housing screws.
18. Check that the oil pump turns freely.
19. Apply a light coat of oil to the seal lip.
20. Install the two dowel pins and new O-ring on the cylinder block.
21. Apply liquid gasket to the cylinder block mating surface of the oil pump.

NOTE:

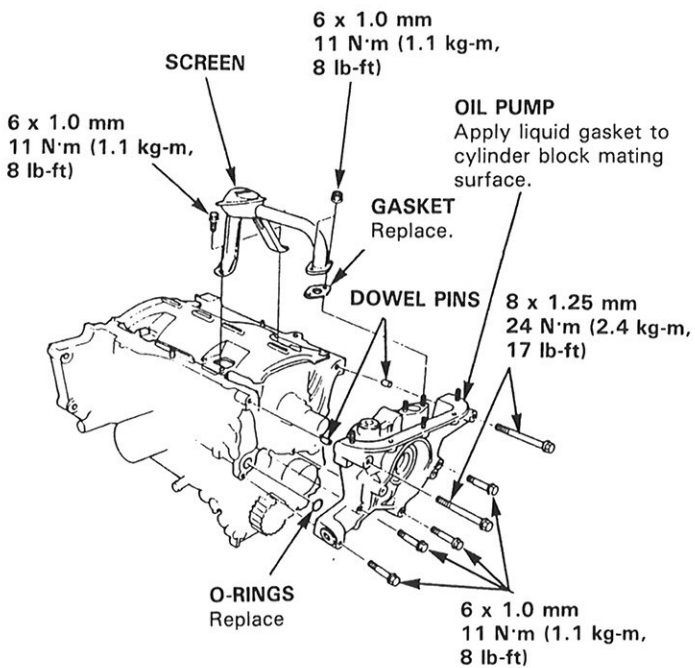
- Use Part No.OY740-99986 for the liquid gasket.
- Check that the mating surfaces are clean and dry before applying liquid gasket.
- Apply liquid gasket evenly, in a narrow bead centered on the mating surface.
- To prevent leakage of oil, apply liquid gasket to the inner threads of the bolt holes.



- Do not allow the liquid gasket to dry before assembly.
- Wait at least 30 minutes after assembly before filling the engine with oil.

22. Install the oil pump on the cylinder block.

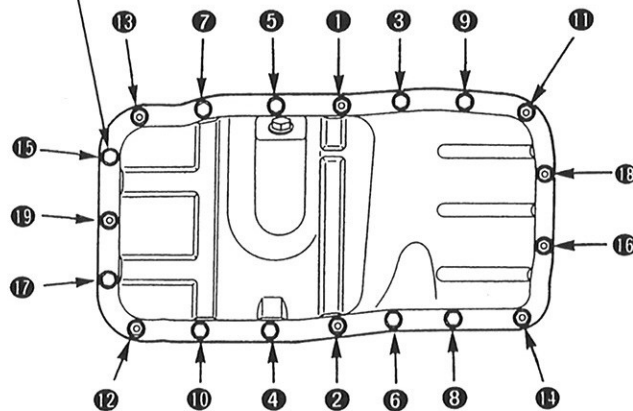
23. Install the oil screen.



24. Install the oil pan.

6 x 1.0 mm
12 N·m (1.2 kg-m, 9 lb-ft)

TORQUE SECUENCE



Cooling

Standards and Service Limits	6-2
Illustrated Index	6-3
Thermostat	
Replacement	6-4
Testing	6-4
Water Pump	
Inspection	6-5
Replacement	6-5

Standards and Service Limits

	MEASUREMENT	STANDARD (NEW)
Thermostat	Starts to open Full open Valve lift at full open	76°C–80°C (169–176°F) 90°C (194°F) 8 mm (0.31 in.) min.
Water pump	Capacity: ℓ (US gal, Imp gal)/ min @ min^{-1} (rpm)	140 (37.0, 30.8) @ 7,600

Cooling

Illustrated Index

NOTE: Use new O-rings when reassembling.

WATER OUTLET COVER

Apply liquid gasket to the mating surface.

BLEED BOLT
10 N·m (1.0 kg-m,
7 lb-ft)

6 x 1.0 mm
11 N·m (1.1 kg-m,
8 lb-ft)

**TEMPERATURE GAUGE
SENDING UNIT**
9 N·m (0.9 kg-m, 7 lb-ft)

THERMOSENSOR
18 N·m (1.8 kg-m,
13 lb-ft)

O-RING
Replace.

WATER PUMP

Inspect for signs of seal leakage of bearing deterioration.
NOTE: Small amount of "weeping" from bleed hole is normal.
Inspection, page 6-5

O-RING
replace.

THERMO SWITCH
28 N·m (2.8 kg-m,
20 lb-ft)

THERMOSTAT HOUSING

6 x 1.0 mm
12 N·m (1.2 kg-m,
9 lb-ft)

O-RING
Replace.

6 x 1.0 mm
12 N·m (1.2 kg-m,
9 lb-ft)

WATER PUMP INLET PIPE

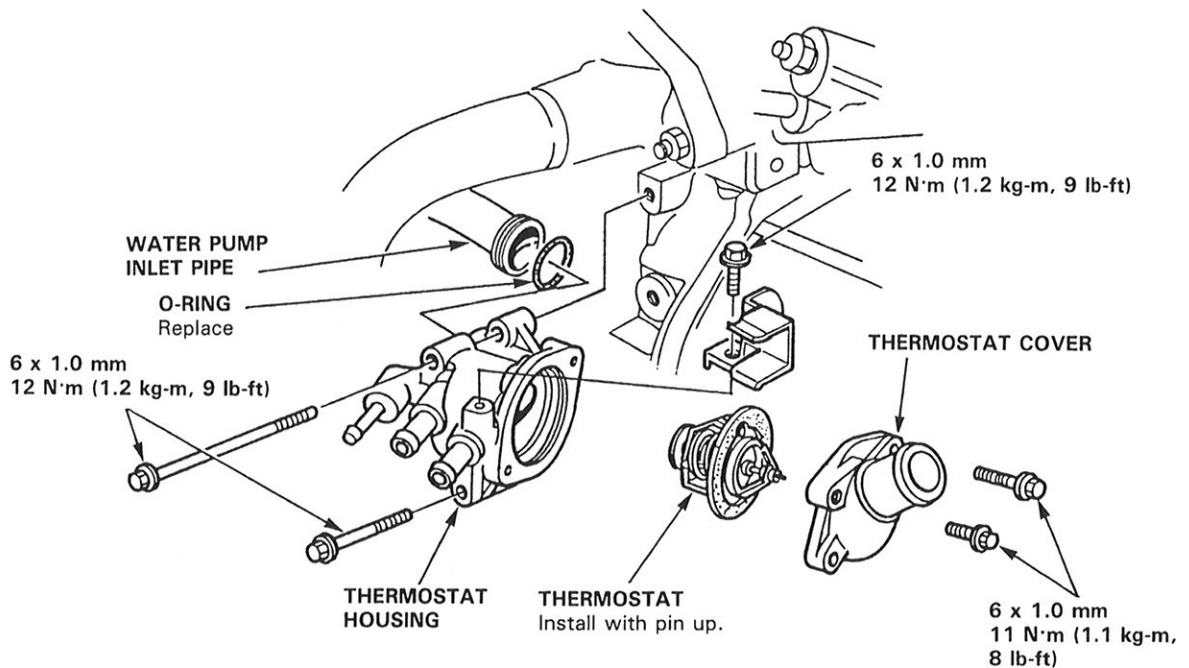
O-RINGS
Replace.

DRAIN BOLT
80 N·m (8.0 kg-m, 58 lb-ft)

Thermostat

Replacement

NOTE: Use new O-rings when reassembling.



Testing

Replace thermostat if it is open at room temperature.

To test a closed thermostat:

1. suspend the thermostat in a container of water as shown.
2. Heat the water and check the temperature with a thermometer. Check the temperature at which the thermostat first opens and at full lift.

CAUTION: Do not let thermometer touch bottom of hot container.

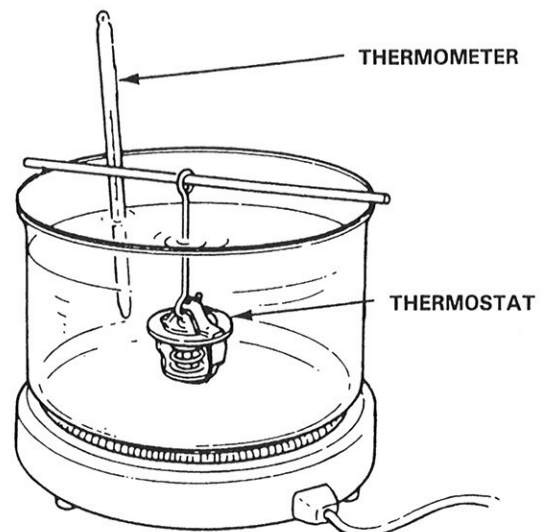
3. Measure lift height of thermostat when fully open.

STANDARD THERMOSTAT

Lift height: 8 mm (0.31 in.)

Starts opening: 78°C ± 2° C (172° F ± 3° F)

Fully open: 90°C (194°F)

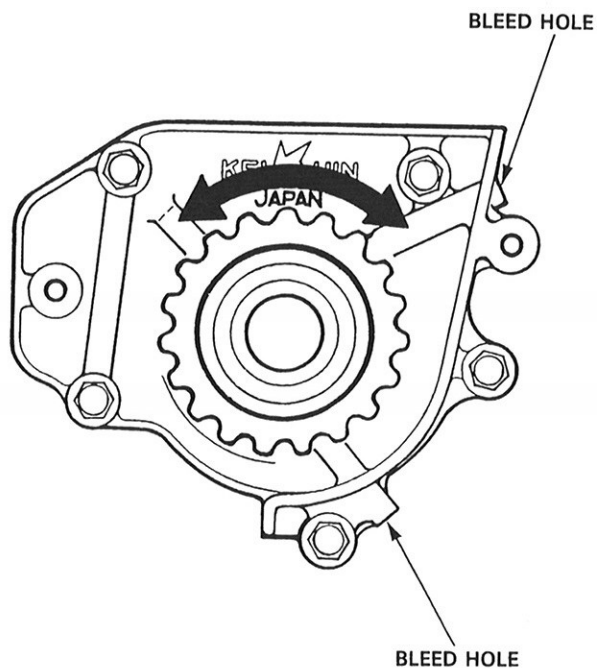


Water Pump

Inspection

1. Remove the timing belt (page 5-43).
2. Check the water pump pulley turn freely.
3. Check the signs of seal leakage.

NOTE: Small amount of "weeping" from bleed hole is normal.



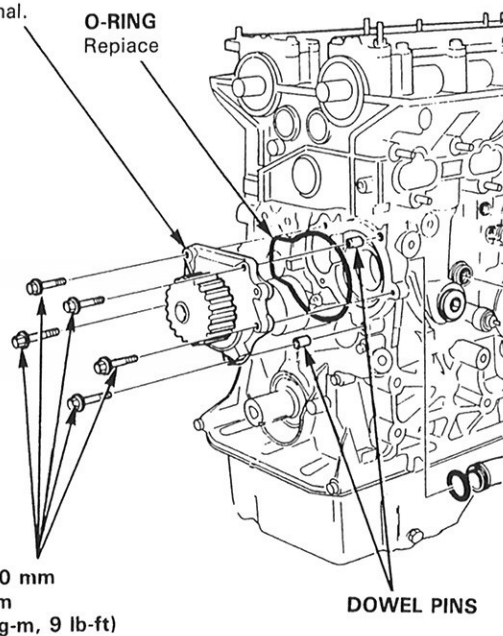
Replacement

NOTE: Use new O-rings whenever reassembling.

1. Remove the timing belt (page 2-5).
2. Remove the mounting bolts and remove the water pump.

WATER PUMP

Inspect for signs of seal leakage or bearing deterioration.
NOTE: Small amount of "weeping" from bleed hole is normal.



3. Install the water pump in the reverse order of removal.

